The Electrical Industry's Weekly Magazine

December 5, 1960

Electrical World

Price 50 Cents

A McGraw-Hill Publication

PEAKING POWER

A Special Report on Sources of Peaking Power And Their Application on Today's Power Systems

. . . page 71

AT NEMA MEETINGS:

Manufacturers move to win prestige battle foreign competition. . . . . p 6

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here it is! A REAL ONE-HAND TOOL

installs
INSULINK® and LINKIT®
one crimp per end!

You'll like this ONE-HAND TOOL . . . from start to finish, you can really work it with only ONE HAND. You can close it with less than a 50 lbs. squeeze; it weighs only 2½ lbs. and is only 12" long. You couldn't ask for an easier service tool . . . it's the only *real* ONE-HAND TOOL.

Position the OH25 once . . . and only once . . . on each side of the INSULINK or uninsulated LINKIT. It has a new die that crimps the entire contact area at one time. You don't have to reposition, you can't overlap crimps, and you never make less than the proper number of crimps.

And, it takes only ONE CRIMP PER END . . . a series of easy, ratchet controlled strokes to make a perfect crimp every time. The new dies cause the conductor strands to rub together, removing the oxide film for more stable, low resistance connections.

Insert stripped wire ends into INSULINK; caps grip and hold conductors.

Get up close to your work. Position ONE-HAND TOOL on INSULINK only once per crimp.

A series of easy strokes complete the crimp. Dies produce oxide removing wiping action between conductor strands.

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60-16

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Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

Electrical World

DECEMBER 5, 1960

Vol. 154, No. 23

What in the *Electrical* World . . .

Traveling, for the electrical power industry, seems to peak twice each year. The first peak extends from mid-March to mid-June. The second, even heavier, starts about Labor Day and runs to Thanksgiving.

It's easy to correlate these surges in activity with the spring and fall convention schedules. And there are good reasons why convention planners choose these periods: they avoid vacation season and bad travel weather; and they take advantage of off-season hotel discounts.

We editors sometimes reflect we're especially penalized by this bi-annual peaking. Often drawn some distance to a conference, we may capitalize on our presence in an area to call on local organizations, with the net effect we may stay away from our desks more than we should. And when two conventions overlap, as they will do, we may get downright bitter.

Actually, at *Electrical World*, we're luckier than many, because of the size of staff, plus our resident field editors, which we can throw into the fray.

Are we of the business press alone in feeling put-upon by this ageless problem? In this changing world, have better travel and communications methods made available the possibility of changing the pattern? Or have they amplified the problem? Finally, would the industry gain if the pattern *were* altered?

We'd really like to hear from others with their thoughts on the situation. Why not drop a line, for publication, or off-the-record, as you choose.

Chuck Hochgesang

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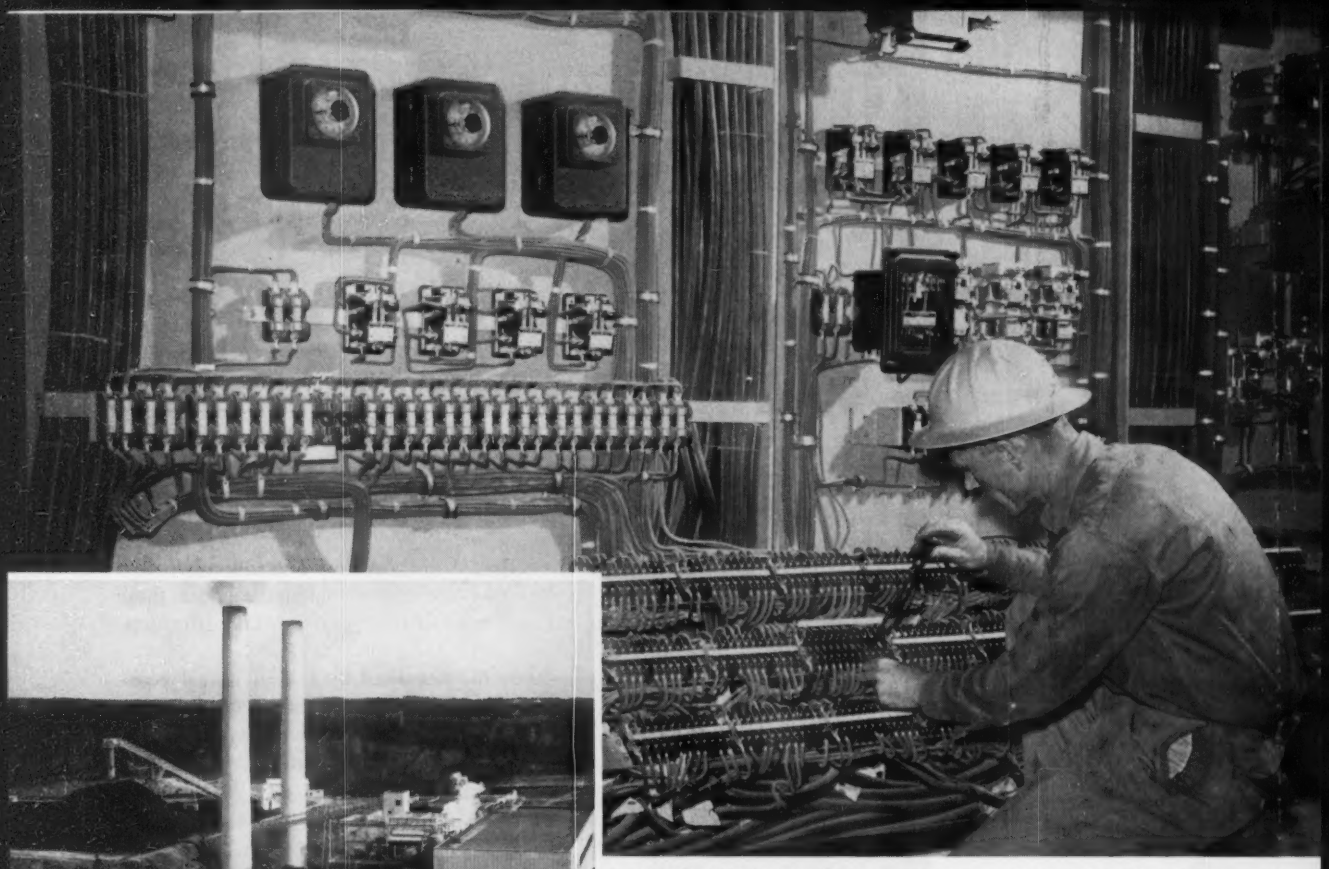
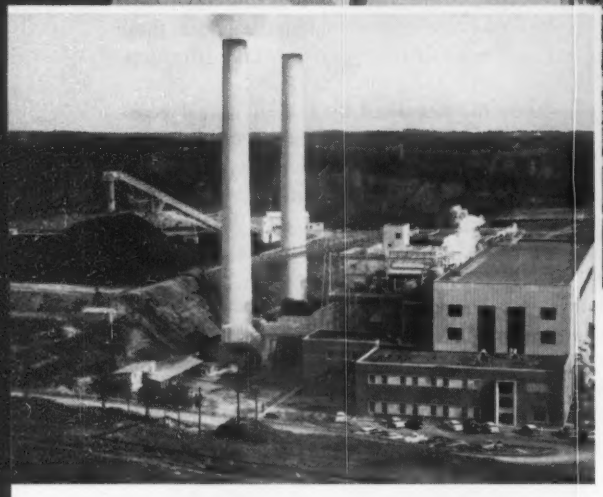




CABLE'BILITY ON THE JOB in the control room of McMeekin Station. Okolite-Okoprene 600-volt and 5000-volt cables were used for all power, control and lighting circuits for both units of the station, assuring long, dependable service.

MODERN COAL-HANDLING FACILITIES at South Carolina Electric and Gas Company's new McMeekin Station—one of the most efficient and economical steam electric generating stations in the world. The new station, producing 275,000 kilowatts of power, uses only 15 cubic feet of space per kilowatt.

Cable'bility at work

Over a Million Feet of Okolite-Okoprene in South Carolina Electric's new McMeekin Station

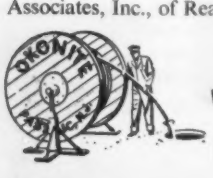
Cable'bility (cā'ble·bil'·i·ty) *new word.* *Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

More than a million feet of 600-volt and 5000-volt Okolite-Okoprene cables are installed in South Carolina Electric & Gas Company's new McMeekin Station, engineered by Gilbert Associates, Inc., of Reading, Pa., installed by T. D. McClure, Jr. Co. of Atlanta, Ga., formerly Miller Electric Co. of Carolina.

Okolite-Okoprene cables had previously shown satisfactory service records in power, control and lighting circuits at South Carolina Electric's second largest steam electric generating facility, Urquhart Station.

The McMeekin installation—one of the world's most efficient and economical generating stations, providing 275,000 kilowatts of power while using only 15 cubic feet of space per kilowatt—uses a variety of Okolite-Okoprene cables. Multiconductor control and power cables were used almost exclusively throughout the plant and switchyard and to connect the coal handling facility and adjacent Hydro Plant. Multiconductor constructions were used to increase mechanical protection since most cables were installed in common in-the-floor or in-the-ground raceways covered by steel plates or concrete slabs.

For the full story on Okolite-Okoprene, write for Bulletin EW-1085. The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.



where there's electrical power . . . there's **OKONITE CABLE**

7223-A

Letters

'Commendable Editorial Courage'

To the Editor:

I completely agree with the sense of your editorial, "Pride in Power Can Cause Perspective Loss, Trouble," (EW, Oct. 24, p 37). Exaggerated claims, based too frequently on careless thinking, can indeed be a source of embarassment to our industry. I think you show commendable editorial courage in seeing fit to call this to the industry's attention.

C. A. Smith, District Manager
Virginia Electric & Power Co
South Boston, Va.

Disagree on Cylinder Cracking

To the Editor:

We have read with great interest the article entitled "Cylinder Cracking Follows Shifts of Older Turbines to Cyclic Duty" (EW, Oct. 24, p 46). We do not agree with Author Sinton that all older units are subject to cylinder cracking due to the thermal stress of cyclic duty and take exception to his statement claiming that the problem is industry-wide.

Allis-Chalmers has a record of no cylinder cracking in the nozzle area due to thermal stresses brought about by cyclic duty because we anticipated this problem in 1934. Since that time we have applied nozzle chests entirely separate from the cylinder on all machines operating with inlet temperatures of 950F and above. Units operating at lower inlet temperatures have nozzle chests separate from, but welded to, the main cylinder. The success of separate nozzle chests pioneered by Allis-Chalmers is well known throughout the industry.

We refer your readers to a 1956 American Power Conference paper, "High Temperature Steam Turbine Design Improvements From Operating Experience," by Hansen, Holmes, and Fleischmann, which discusses facts regarding design of separate nozzle chests applied by Allis-Chalmers over a period of 26 years and, within the past decade, its application of advanced ring-type chests.

Recently, Gulf States Utilities contracted with us to completely automate two older units, rated 35-Mw respectively, now used only for peaking purposes (EW, Nov. 21, p 64). In addition to freeing operating

(*Continued on page* 111)

Dateline . . .

Asotin, Wash.—The decisive defeat Nov. 8 of a proposal to form a public utility district in Asotin County, Wash., by a margin of more than three to one demonstrated again that when an investor-owned utility presents the facts of its case to the people it can get their overwhelming support.

Washington Water Power Co decided to take its case directly to the people when the PUD proposition was placed on the ballot in Asotin County, where WWP has 4,560 electric customers and 3,632 water customers. The results—4,029 to 1,260 against the PUD—were even more favorable than the most optimistic prediction at WWP.

"The results in the Asotin County PUD election again clearly demonstrate, that when people know the facts they will want and support utility ownership by investor-owned companies," George M. Brunzell, WWP president, said.

How did WWP accomplish the task?

It was done with a well-organized effort based primarily on personal contact. The company embarked on an ambitious door-to-door campaign with the goal of reaching each of the county's more than 6,000 registered voters. WWP employees actually contacted more than 5,100 during a two-month period before the election. Copies of two booklets were handed out in the campaign. One explained the Washington state PUD law and the other described the powers of PUD commissioners. Both were prepared by the WWP staff. This was backed up by newspaper ads and some radio and TV spots. The whole effort was directed by Kimball I. Jack, vice president in charge of general sales, promotion and information.

"There has not been an election won by PUD proponents in the state of Washington since 1940," Jack declared. "We were confident of winning this one but we did even better than we expected."

(*Continued on page* 69)

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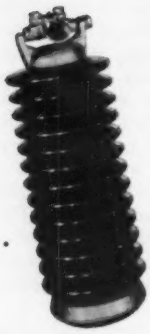
Postmaster . . . Please send form 3579 to Electrical World, 330 W. 42nd St., New York 36, N. Y.

CLAMP

THE LAPP CLAMP IS INTERCHANGEABLE

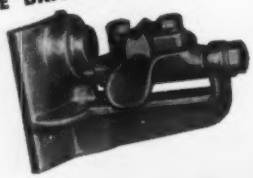
Five sizes of clamps, in aluminum or malleable, each with reversible keeper, provide correct fit for all conductor sizes .25" to 2.00" dia. All clamps are interchangeable for use on



CLAMP-TOP LINE POSTS . . .

CLAMP-TOP LINE POSTS WITH INTEGRAL BASE-AND-GAIN FOR ARMLESS CONSTRUCTION . . .

CLAMP-TOP GROUND-WIRE BRACKETS



-TOPS?

THE LAPP CLAMP IS EASIEST TO INSTALL

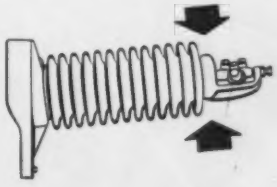
For original installation, insulator (or bracket) with clamp attached, is mounted to crossarm or pole. Keeper cap screws are loosened, and one removed. With keeper rotated out of position on remaining cap screw, conductor is dropped into place. Keeper is brought back to position, cap screw replaced, and both cap screws tightened. Cap screws have captive lock-washers so there is *only one loose part* per insulator throughout installation.

THE LAPP CLAMP IS EASIEST TO WORK WITH HOT-LINE TOOLS

No special tools required for insulator change-out. A trunnion cap screw is merely backed off, and conductor (with clamp attached) lifted out of position. The same clamp will slip into position in a replaced insulator and be secured by tightening trunnion cap screw. *No loose parts* throughout insulator change.

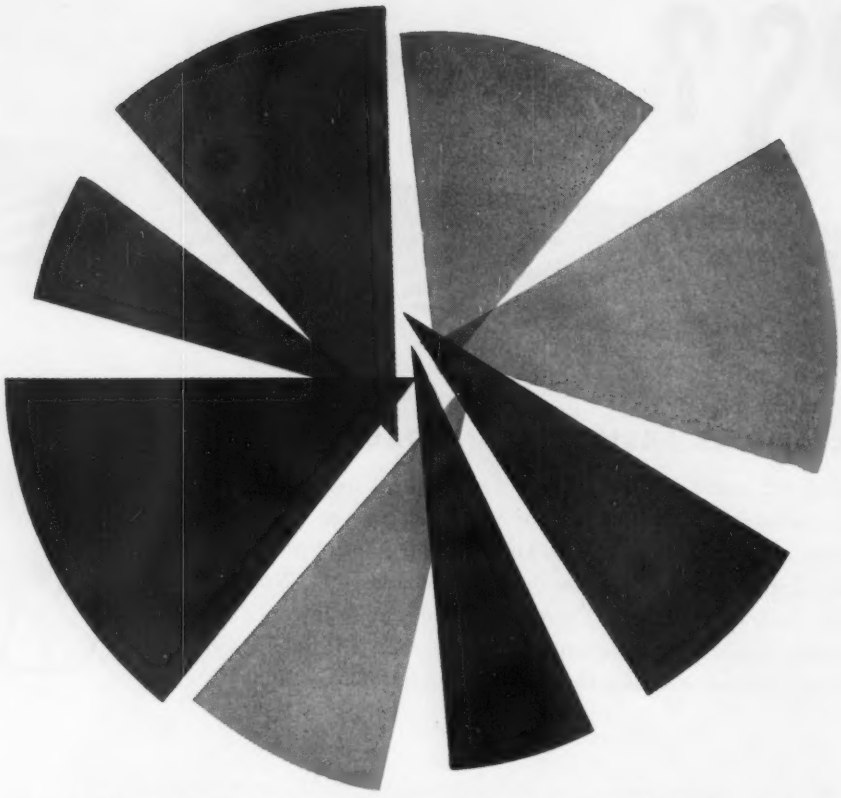
THE LAPP CLAMP-TOP IS MOST DEPENDABLE

A principle of Lapp Post design is the *external* attachment of hardware—*bases and caps*. This assures that the porcelain body be loaded only in large-area low-intensity compression. This design takes full advantage of porcelain's superior compression strength, and provides an assembly greatly more secure than one subject to the high-intensity tension loading introduced by internal pins and inserts.

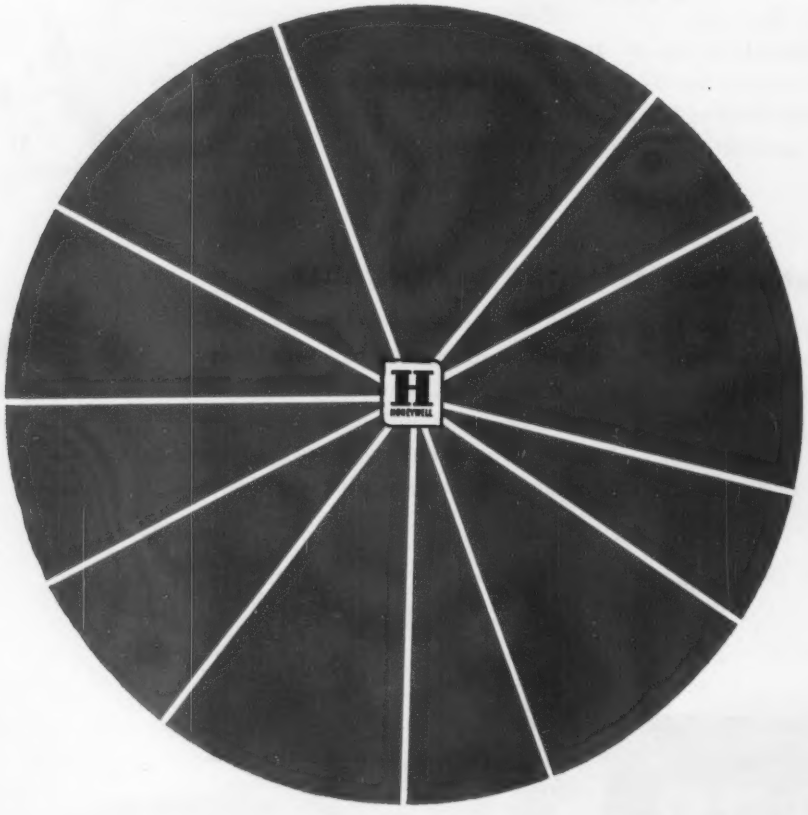


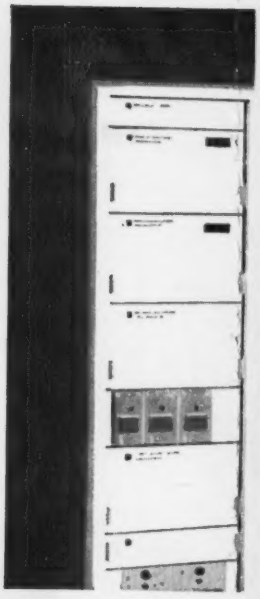
Lapp

For new ideas on economical, efficient line and station construction read the new Lapp Catalog Eight. For your copy, write Lapp Insulator Co., Inc., Le Roy, N. Y.



YOUR CONTROL SYSTEM—HYBRID OR HONEYWELL?





The answer can be important to you. True, you can combine several makes of instruments into a system and get adequate results. But you usually pay a penalty for hybrid systems. There's the burden of responsibility for engineering and maintaining the system. There's the question of whether it will do what you want it to. There's the problem of modifying various makes of components to work together. And there's the inconvenience of buying instruments and spare parts from several suppliers instead of one.

Single-Source Responsibility. You avoid all of this with an all-Honeywell data processing or automatic control system. All components, from primary measuring elements to final controls, are supplied by Honeywell. If your requirements call for an analog or digital computer, Honeywell can supply it. From our systems engineers you get the advantage of experience gathered over 75 years of measurement and control work in scientific, military and industrial operations. And Honeywell takes full responsibility for the system, from initial planning through installation and startup, and even including maintenance.

Conserve Your Working Capital. You can conserve working capital by leasing a Honeywell system from one to five years, paying for it as you use it. Because you lease at today's prices, you're protected against possible future price increases. Because you deal *only* with Honeywell, you needn't worry about long negotiations with third parties.

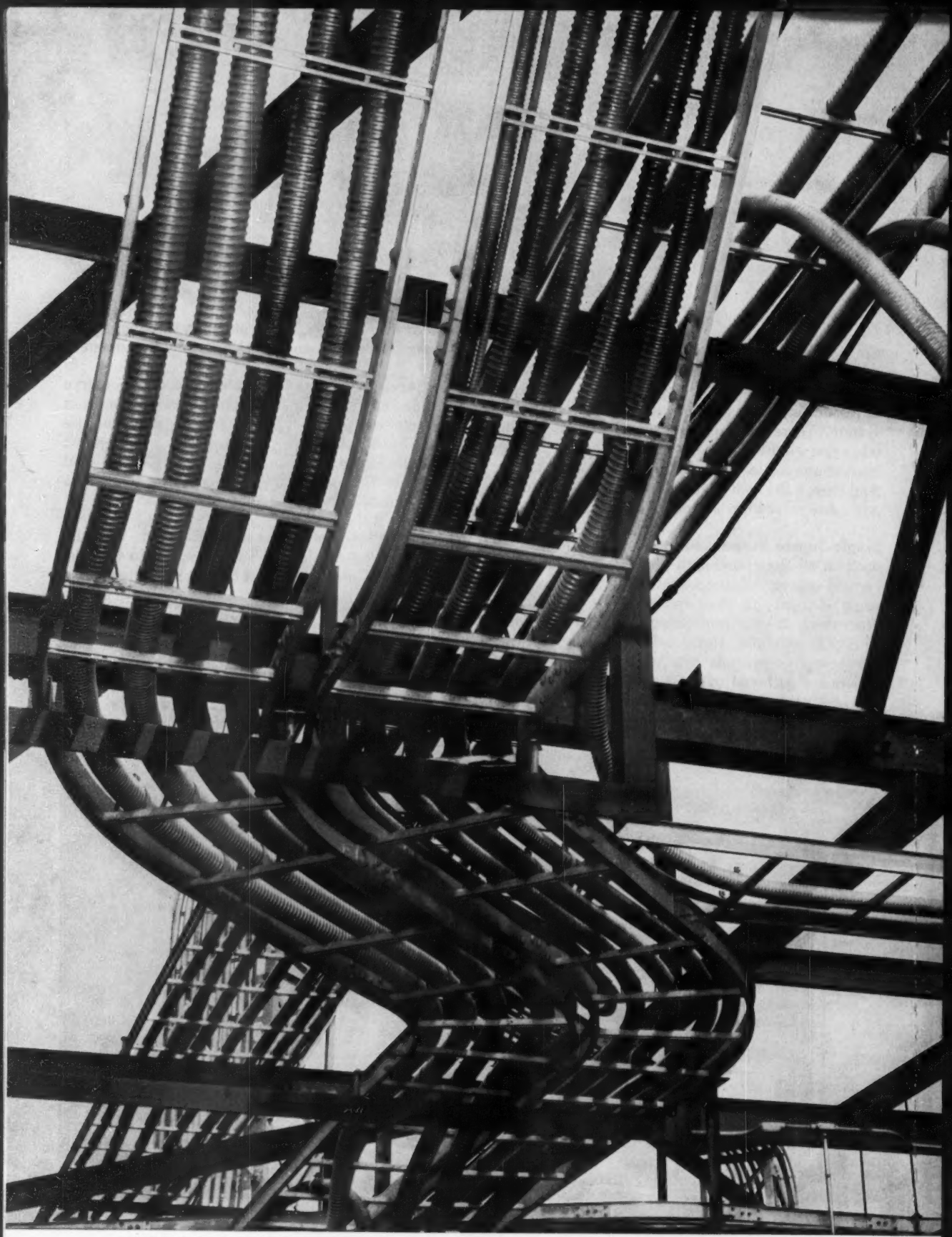
MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pennsylvania. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

75th YEAR PIONEERING THE FUTURE

Honeywell

First in Control

SINCE 1885



USS Tiger Brand Armorlokt cable in open racks costs less to install, carries more power and can be easily maintained.

Power for new refinery supplied by overhead installation of USS Tiger Brand Armorlokt Cables

Electrical power for this highly automated refinery of the Standard Oil Company (Ohio) at Toledo, Ohio comes into the transformers at 69,000 volts and is stepped down to 4,160 volts for the various power feeders. These are carried to unit substations of the processing plant on racks supporting the USS Tiger Brand Armorlokt Cable. At the substations, the voltage is reduced to 440 volts and from there is run to the starter racks for motors which drive the process pumps.

This is the first time that armored cable has been used in any of Sohio's refineries. The initial cost was less than for a conduit or concrete duct installation in the ground. The cables in air have a higher current carrying capacity for a given size cable. Since heat can dissipate quickly, a smaller cable can be used to carry the same power.

Less costly construction was possible at substations because the Armorlokt Cable was easily accessible from overhead and did not require the construction of conduit openings in a concrete ground slab.

Flexibility. Besides ease of installation, USS Tiger Brand Armorlokt Cable can be readily run around obstructions, because of its flexibility. Capacity can be quickly and economically added for future needs for more power.

Why not investigate USS Tiger Brand Armorlokt Cable—not only for new installations but for bringing old systems up to date with the least cost for installation. Write or call American Steel & Wire, 614 Superior Ave., N. W., Cleveland 13, Ohio.

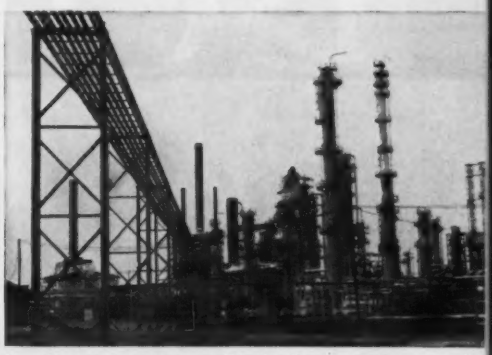
USS, Tiger Brand and Armorlokt are registered trademarks

USS Tiger Brand Electrical Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

Substation showing cable racks supporting USS Tiger Brand Armorlokt Cable with varnished cambric insulation. Sizes include cables of 500 MCM with voltages of 5,000 and 600 volts.

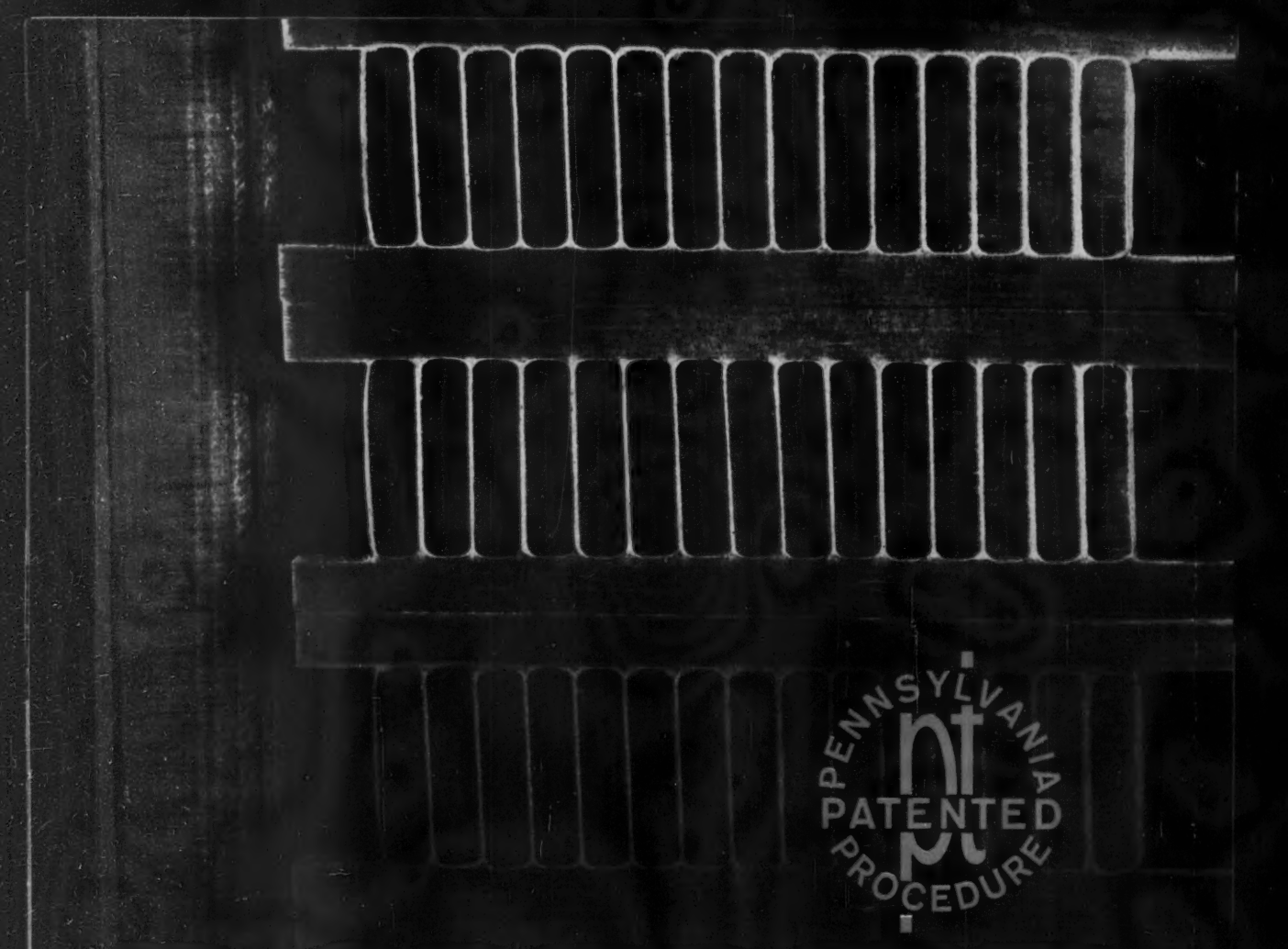


New Standard Oil Company (Ohio) refinery at Toledo, Ohio with a capacity to process 60,000 barrels of crude oil per day. Engineers and constructors: The M. W. Kellogg Co., Electrical Contractors: W. W. Clark Corp.

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad

Watch United States Steel's special Christmas show, **The Coming of Christ**, in Color on NBC-TV, Wednesday, December 21, 8:30 P.M., E.S.T.



BONDED

Rugged and Corona-free

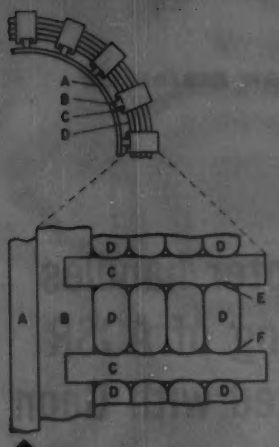
There's a special reason why Pennsylvania Transformer windings have the strength to take short circuits and are free from corona-producing voids. It's the fully patented bonding method using pre-applied adhesive—eliminating troubles with other methods.

Unbonded windings are structurally weak. But bonding by the usual dipping in an insulating adhesive can trap air in small pockets and prevent proper oil impregnation of insulation. Corona in these voids leads to insulation failure.

adhesive pre-applied where necessary makes the difference

Pennsylvania bonds high-voltage windings rigidly together by *pre-coating only the insulating spacers* that are aligned between uncoated conductors. The heat-reactive coating, of non-resoftening adhesive, is cured while the windings are under high pressure. Result: Close, voidless bonds, unquestionably complete oil impregnation, plus grooves for the conductors

PENNSYLVANIA



Schematic sketch showing relation of conductors and adhesive-treated spacers in a pancake-type winding. The enlargement shows conductors compressed between spacers.
A—Barrier tube
B—Axial spacers cemented to (A)
C—Radial spacers, keyed to (B), with top and bottom surfaces pre-coated with adhesive
D—Insulated conductors
E—Pressed depression in spacer (C)
F—Adhesive fillet

High-voltage coils for a 30,000-kva, 69,000 GrdY/39,840—13,200 △ volt, Class FOA transformer, being placed under calibrated spring pressure preparatory to oven drying and curing. Adhesive-treated radial spacers between "pancakes" are in line with pressure blocks at ends.

Section through pancake-wound coils separated by radial spacers.

FOR LIFE

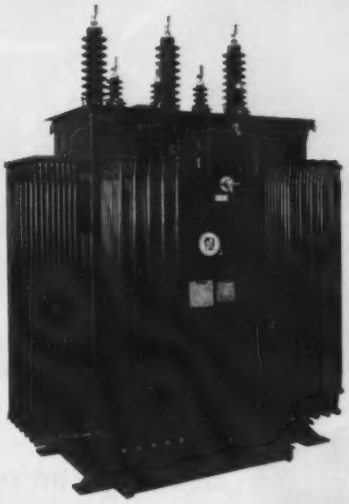
in the insulating spacers. Conductors cannot roll or shift position under short-circuit stress.

cooling oil flows unrestricted

Not only are the windings "welded" into a rigid structural unit that allows complete penetration of insulating oil to fill all voids, but cooling efficiency is improved. There is no plugging of oil ducts between spacers as can happen when windings are bonded by dipping.

Pre-applied adhesive bonding is Pennsylvania's practice for all types of high-voltage windings in both core- and shell-form transformers. The added strength and freedom from insulation voids assures you a big plus value in service dependability.

Descriptive information on Pennsylvania Power Transformers will be supplied on request. Write Power Sales Department, Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pennsylvania.



Standard 5000-kva, 67,000 △-12,470Y/7200 volts self-cooled (Class OA) transformer. High-voltage windings are of pancake-wound coils bonded to radial spacers with heat-reactive adhesive.

POWER TRANSFORMERS

McGRAW EDISON

PENNSYLVANIA TRANSFORMERS pt

News about

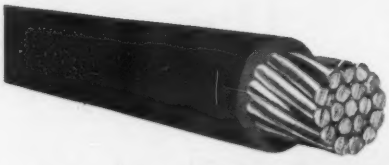
B.F.Goodrich Chemical *raw materials*

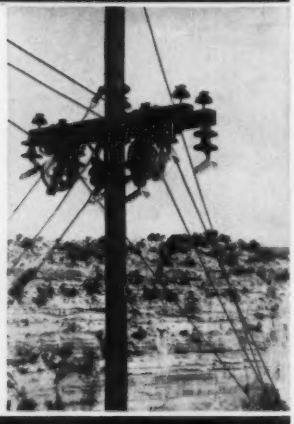
Helicopter handles stringing of ACSR insulated with Geon

Length of spans and difficulties of terrain created problems for Arizona Public Service Company in this 75,000-ft cable stringing job on the southern rim of Grand Canyon. The longest of the 20 spans is 3000 ft, with an elevation drop of 1800 ft.

With helicopter handling and other tough installation and operation problems, selection of Geon vinyl for insulation is a natural. Geon is tough. It withstands abrasion and provides the kind of resistance to weathering and heat that gives satisfactory service for severest operating conditions. Dielectric properties are excellent. Geon also provides another advantage: it was easy to color this insulation black to match the rock formations of the canyon wall.

Here's another example of the way that Geon vinyl solves product problems —reasons many manufacturers use Geon to improve products and open new markets. For more information, write Dept. GX-13, B.F.Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.





75,000 ft *of 101,800 CM, 12/7 ACSR cable with a 2/64th inch covering of Geon vinyl was supplied to Arizona Public Service Company by Kaiser Aluminum & Chemical Corporation. B.F.Goodrich Chemical Company supplies the Geon vinyl.*

Geon VINYLS

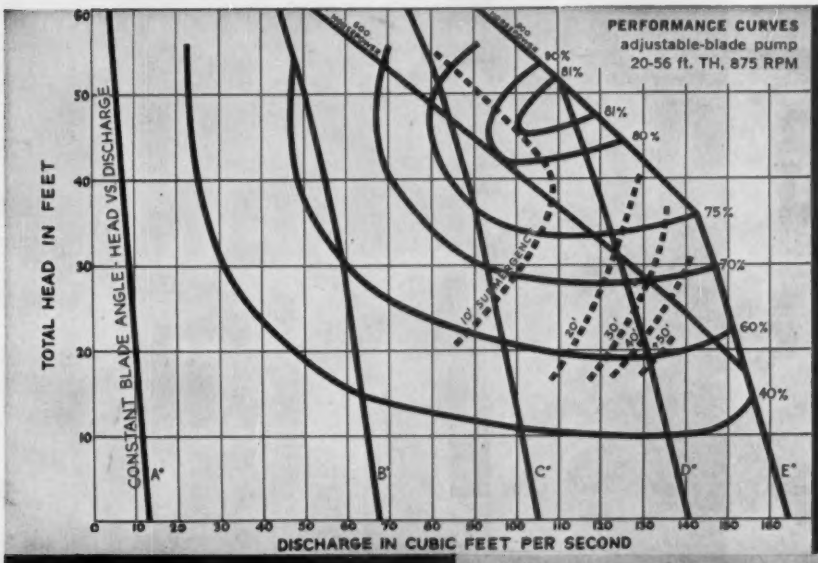
B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

ALLIS-CHALMERS

A-1393



Performance curves of the A-C adjustable-blade axial flow pumps for Willow Glen illustrate their extreme flexibility. Pump operation is not restricted to a single head-discharge curve as is the case with fixed-blade pumps, but provides any discharge and head combination within the limits of motor horsepower and proper submergence.

Stone & Webster Engineering Corp. is designing and constructing the Willow Glen Plant at St. Gabriel, La. on the Mississippi River for Gulf States Utilities Co.

Flexibility and efficiency make Allis-Chalmers adjustable-blade pumps choice for Willow Glen

Two 30-inch Allis-Chalmers adjustable-blade axial flow pumps provide condenser water for Unit #1 at the new Willow Glen Power Station. To meet requirements at minimum river level, with water temperatures that vary between 39°F and 90°F, the pumps were designed to deliver a total of 76,000 gpm against a 54-foot total head.

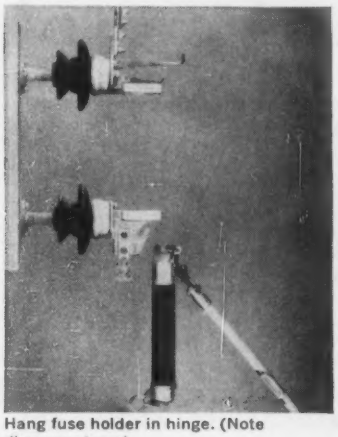
Extreme variation of suction pool elevation and the flexible condenser operation required for this station made adjustable-blade pumps the logical and economical choice. A-C adjustable-blade pumps attain relatively high efficiencies over a wide discharge and head range. This is accomplished by varying the pitch of the impeller blades while the pump is operating at constant speed. This adjustability keeps pumping costs at a minimum by combining low starting torque with high average efficiency.

Pump Bulletin 165 will give you complete information on high capacity axial flow pumps. To get your copy, write to **Allis-Chalmers,** *Hydraulic Division, York, Pennsylvania.*

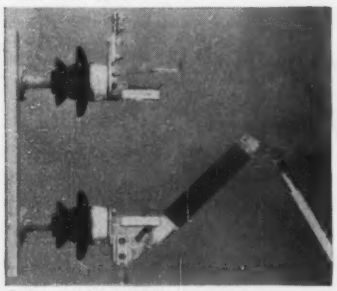
LOW-COST SWITCHING

HOW THE SM-4 SWITCHES

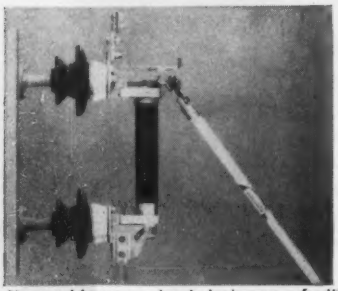
Photo at right shows the fuse being opened with Loadbuster. Photos below show closing sequence with conventional handling tool.



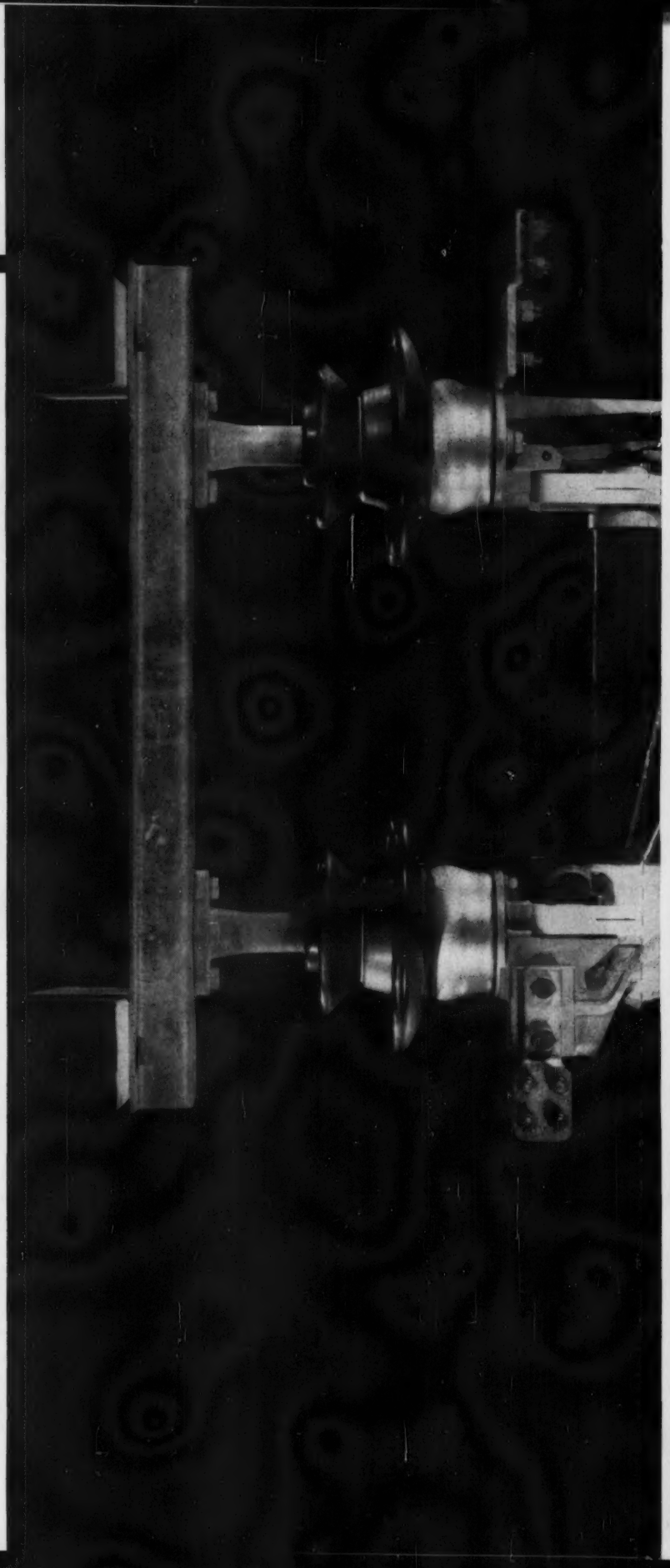
Hang fuse holder in hinge. (Note disconnect gap) . . .

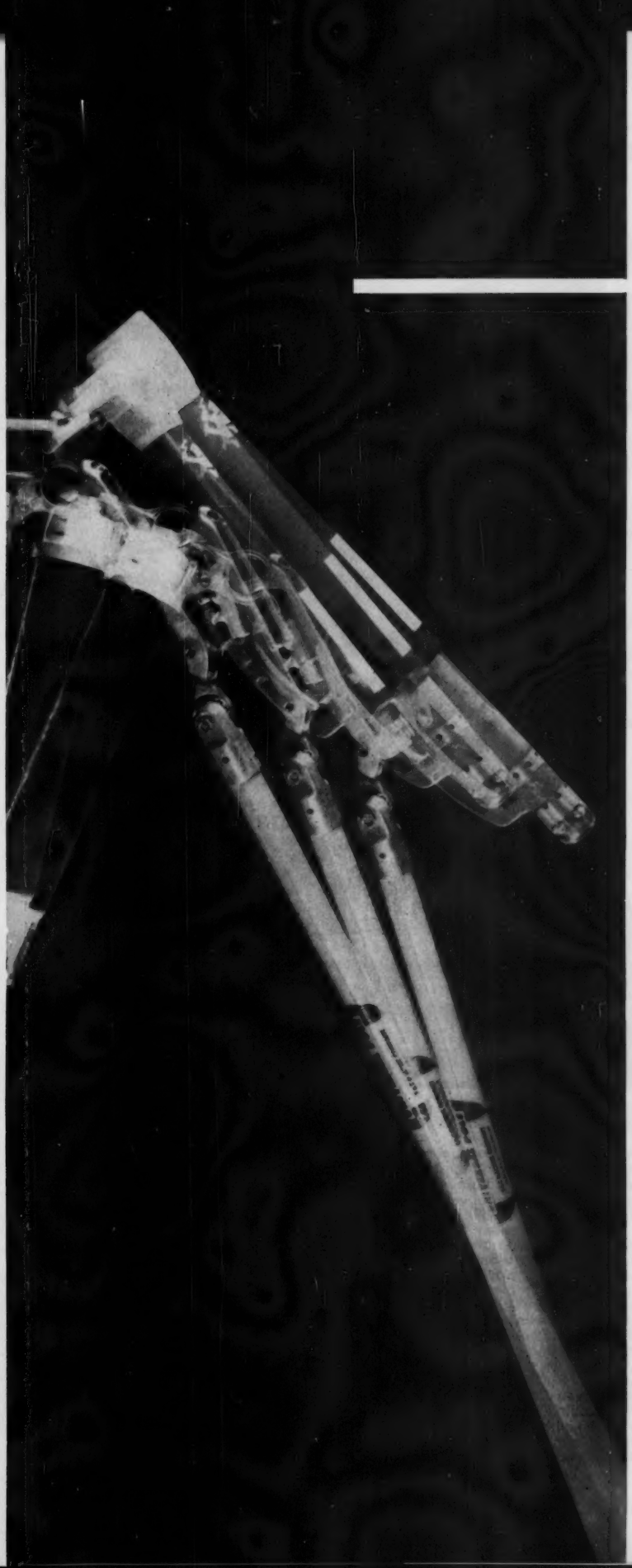


Swing holder closed . . .



No need to worry about closing on a fault —the SM-4, a boric acid fuse, interrupts effortlessly.





Now even power fuses operate with S&C's Loadbuster® — no need to add a disconnect

That's right . . . no disconnect required! If it's S&C's outdoor SM-4 Power Fuse, you switch with the fuse itself—plus Loadbuster.

On transformer primaries there's no separate investment in disconnects for energizing, or for de-energizing and isolating. For line sectionalizing the same holds true—and then some! With Loadbuster it's possible to drop the line, split the load, even dump the load—up to 14.4 kv.

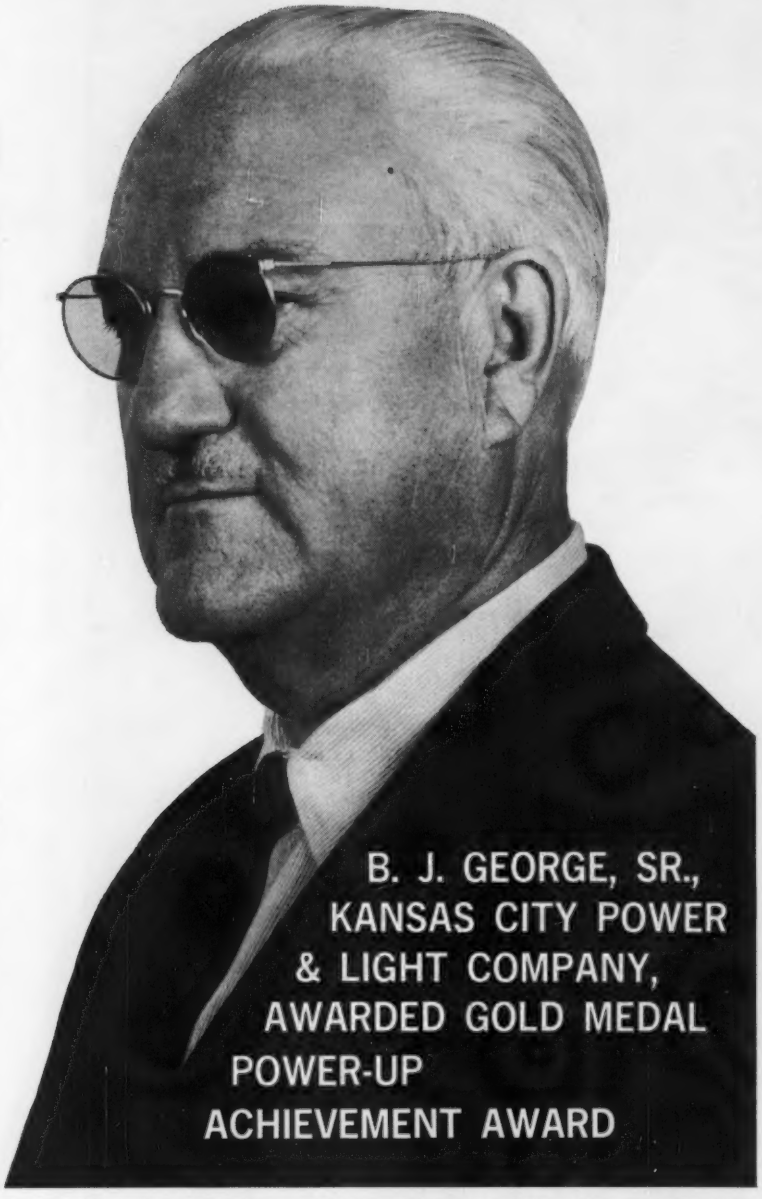
Here's how it works. The SM-4 Power Fuse is equipped with an attachment hook to accommodate Loadbuster. Just hook Loadbuster onto this hook and into the pull ring, pull fuse open and the circuit is interrupted. Result: full load switching at full voltage with no arcing, no contact burning. In one device you get full switching and isolation as well as fault protection.

The key to the Loadbuster system of universal, low cost load switching? Portability! . . . bringing the interrupting device to the power fuse, disconnect, or cutout only when it's needed. In this way the cost of Loadbuster is spread over all the fuses, disconnects, and cutouts on the distribution system.

For more information contact S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Ill. We will be glad to give you a demonstration of how Loadbuster works.

S&C ELECTRIC COMPANY

S&C



POWER-UP
Achievement
Award

Increasing load on a customer's 1925 d-c generating plant posed a difficult problem for Mr. B. J. George, Sr., Kansas City Power & Light Company consultant. Should additional d-c capacity be provided . . . or new a-c generating equipment installed? Should all major load power be purchased? Should steam or electricity be used for air conditioning? Mr. George's solution earned him the Gold Medal Power-Up Achievement Award.

Working closely with the customer, consulting engineers, contractors and fellow employes, Mr. George recommended all purchased power except for boilers to provide building and water heating. Four substations were installed, along with a new a-c distribution system to serve lighting, small motors, office equipment and the conversion of loads to the new system. The customer now has ample provision for future load growth.

Bronze Medal Power-Up Awards were won by Raymond J. Bergmann, The United Illuminating Company (New Haven, Conn.); William J. Carkeek, Puget Sound Power & Light Company (Bellevue, Wash.); William F. Doherty, Union Electric Company (St. Louis, Mo.); Louis E. Krieg, Jr., Pennsylvania Power & Light Company (Allentown, Pa.); Bernard M. Lyons, The Cleveland Electric Illuminating Company; Paul H. Rickert, Metropolitan Edison Company (Reading, Pa.). The awards were based on the sum total of each man's effort, including the results to the customers, the extent of cooperation within the Power-Up teams and that gained from architects, consultants, contractors and manufacturers.

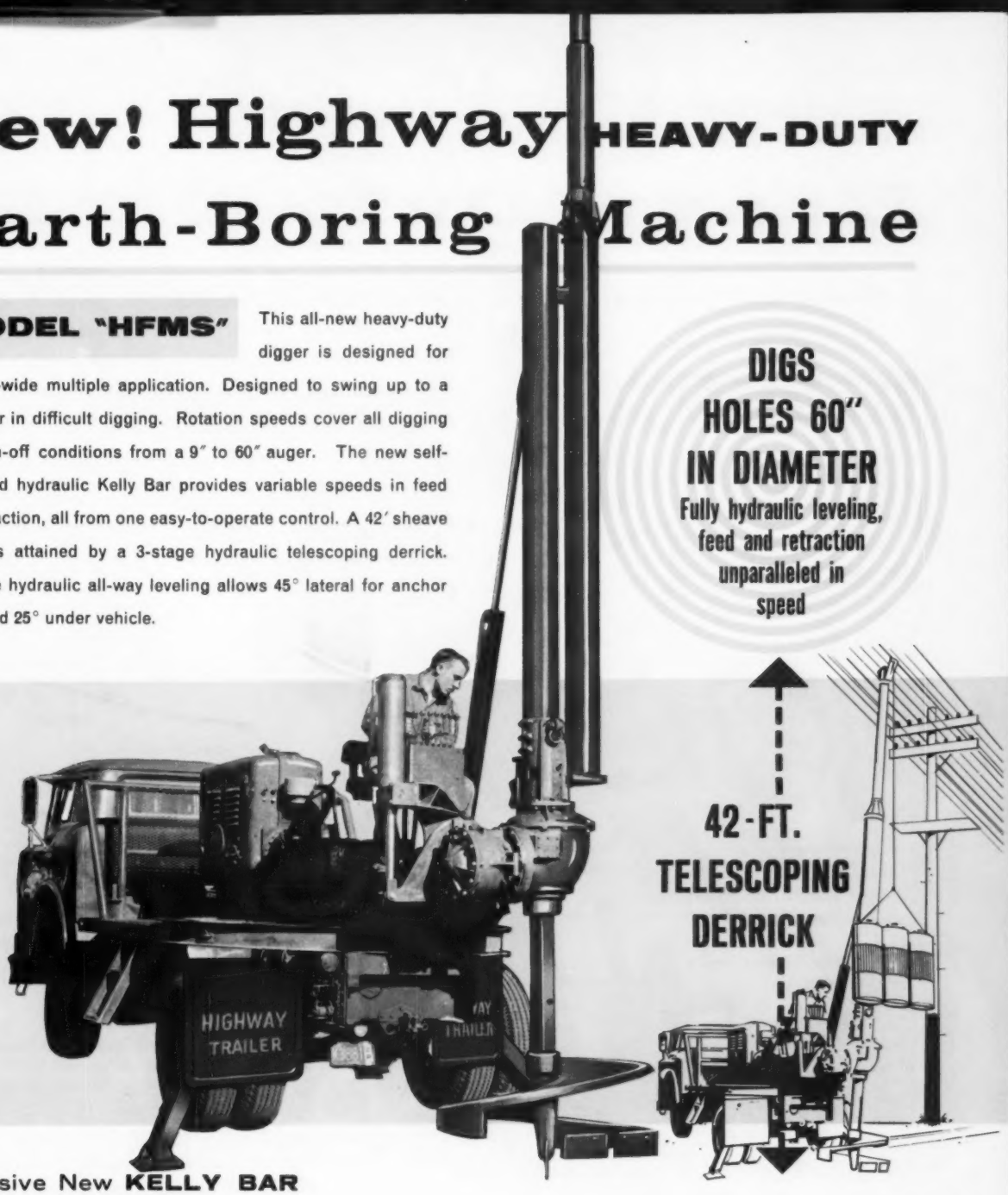
The seven award winners typify the power sales engineers who perform a vital role in helping America increase productivity through electrification. The Power-Up Achievement Awards are presented annually in recognition of outstanding service to industry. Power-Up is a program of electrical service sponsored by the Westinghouse Electric Corporation. **You can be sure . . . if it's Westinghouse.** J-97251

Westinghouse

new! Highway HEAVY-DUTY Earth-Boring Machine

MODEL "HFMS" This all-new heavy-duty digger is designed for industry-wide multiple application. Designed to swing up to a 60″ auger in difficult digging. Rotation speeds cover all digging and spin-off conditions from a 9″ to 60″ auger. The new self-contained hydraulic Kelly Bar provides variable speeds in feed and retraction, all from one easy-to-operate control. A 42′ sheave height is attained by a 3-stage hydraulic telescoping derrick. Versatile hydraulic all-way leveling allows 45° lateral for anchor holes and 25° under vehicle.

DIGS HOLES 60″ IN DIAMETER
Fully hydraulic leveling, feed and retraction unparalleled in speed

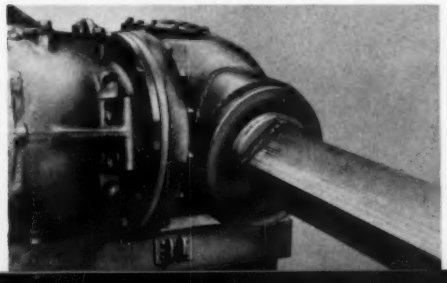


42-FT. TELESCOPING DERRICK

Exclusive New KELLY BAR

The hydraulic Feed Ram is encased in a 4½″-square Kelly Bar. This rugged bar is solidly enclosed at the auger end. The only hydraulic seal required is on the top actuating ram, completely protected from outside contamination.

The Kelly Bar is rotated by an enclosed gear collar. This application completely insures both hydraulic system and gear case against any possible entry of foreign matter.



HIGHWAY

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SPECIAL FREE 10-POINT EQUIPMENT CHECK

Highway is offering a free 10-point maintenance check on all Highway earth-boring machines. Take advantage of this special offer. See your Highway distributor or write Highway Trailer Industries for additional information.

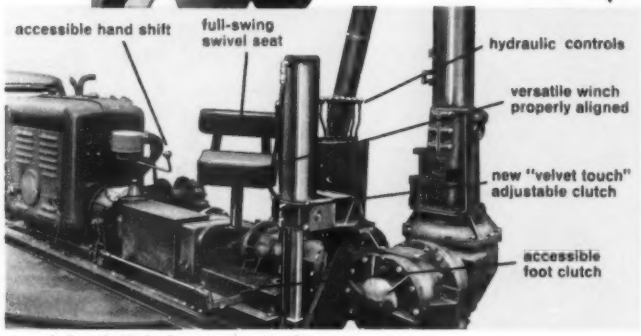
new! Highway Heavy-Duty Digger

LARGE-HOLE DIGGING AND POLE-SETTING MADE QUICK AND EASY!

MODEL "HCBMS"

DIGS HOLES 35′ DEEP— 42″ IN DIAMETER

All-way hydraulic or mechanical power leveling, allowing the widest range of digging angles in the industry



All controls easily accessible from comfortable seat. Power access outlets for portable tools — "Generac" 110-220-volt outlets for electrical power tools. New, more powerful swing or spotter base mount, with hydraulic stabilizers.

3 NEW ALL-PURPOSE UTILITY BOXES

Side Boxes and G. S. Bodies for all needs. Rustproof galvaneal steel — for ½-, ¾- and 1-ton vehicles — all makes.

Model HT — Top Box — Full storage unit with trays and lock doors.

Model HC — Conversion Unit — wheel-mounted; full storage boxes with lock doors.

Model HB — General Service — complete body and storage facilities.

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HIGHWAY®

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- ☐ Model "HCBMS" Earth-Boring Machine
- ☐ All-purpose Side Boxes and G. S. Bodies
- ☐ General-line folder

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SALES AND SERVICE IN PRINCIPAL CITIES

Electrical World

DECEMBER 5, 1960

Vol. 154, No. 23

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CRITICAL SUBSTATION DESIGN saves $400,000 via probing of standard practices.

LATE NEWS ▶ **First highlights** of National Assn of Railroad and Utilities Commissioners Convention in Las Vegas . . . **Committee on Engineering** suggested possibility of developing percentages or weightings which could be applied to residential, commercial, and industrial groupings of customers in calculating cost of service. . . . **Committee on Valuation**—Looking toward the future, there will be a continued high plant growth rate. R & D plans will be more spectacular. Prices will probably continue to rise under the impetus of demands for higher wages and continuing high taxation. . . . **NARUC President C. R. Perrine**—We recognize the need for sound regulation that tries to preserve the free enterprise system at the same time we protect the public against unreasonable rates and practices. . . . **Committee on Progress in Regulation**—Majority of rate cases decided during the year recognized as a current expense a provision for deferred income taxes in cases where the companies used accelerated depreciation rather than straight line depreciation for tax purposes . . . **Utility rate making**—Effort must be made to treat objectively the effects of inflation . . . **Committee on Nuclear Energy**—NY, California, and Texas appear to be well ahead of the others in preparation and desire to assume the controls provided by new Section 274 of Atomic Energy Act.

Power Authority of State of New York spokesman reaffirms state body's desire to build nuclear plants with federal financial aid. PASNY, which built Niagara and St Lawrence projects wants to share atom development with private groups, but rely on them for distribution . . . **Empire State Utilities Power Resources Assn** reportedly withdraws proposal that AEC help finance two-pronged R&D approach to determine whether 300-Mw BWR with nuclear superheat or high temperature gas-cooled reactor would be most economical.

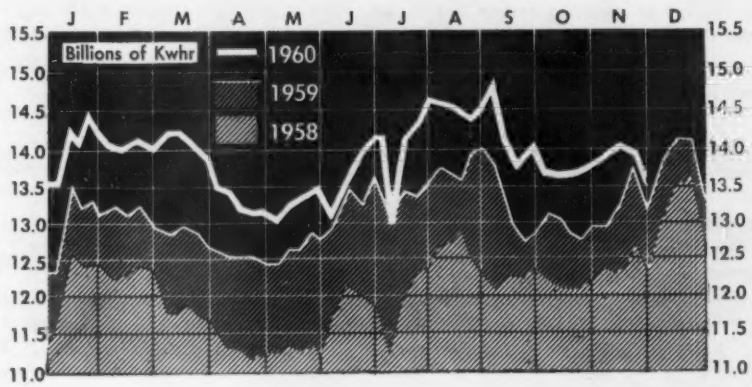
New principle of magnetohydrodynamic electric generator with outputs much higher than previous model is getting shakedown test. Project is being sponsored by AVCO Corp and American Electric Power, representing 10 utilities.

Galloping conductors made three 230-kv lines of US Bureau of Reclamations system in Minnesota and Dakotas almost unusable for more than 24 hours as heavy winds and ice hit northern plains area in first snow of the season. Two 115-kw lines were also damaged. Northern States Power has some icing on 34.5-kv lines.

Management change—W. R. Snyder named president of Metropolitan Edison Co. He comes from position as president of Manila Electric Co, Philippines.

WEEKLY POWER OUTPUT—Up 2.5%

(Week ending Nov. 26), Kwhr 13,500,000,000



Per Cent Change From Previous Year

	Nov. 12	Nov. 19	Nov. 25
Total U. S.	+ 6.3	+ 1.7	+ 2.5
New Eng.	+ 5.6	+ 1.2	+ 3.1
Mid. Atlan.	+ 3.8	− 0.5	− 0.6
Cent. Indust.	+ 4.6	− 1.6	− 3.0
West Cent.	+ 5.2	+ 0.8	+ 0.9
Southeast	+ 9.8	+ 4.2	+ 3.5
South Cent.	+ 8.3	+ 7.3	+ 8.5
Rocky Mount.	+17.2	+11.1	+13.2
Pacific NW	+ 3.1	− 1.8	+12.1
Pacific SW	+ 5.7	+ 4.5	+ 6.2

Seasonally Adjusted Index 264.8

Week Ago 269.7 Year Ago 260.3

Source: Edison Electric Institute

Supply Lines

CLEVELAND ELECTRIC ILLUMINATING ADOPTS 'BUY AMERICAN' POLICY

Cleveland Electric Illuminating Co has adopted a "Buy American" policy, but provides for exceptions to it under unusual circumstances. Copies of the written policy statement went out to selected suppliers in November. This is believed to be the first policy statement on foreign buying to be issued by a large electric utility in recent years.

The CEI statement says simply, "It is the policy of the company to buy American." It then explains, "The objective of this policy is to promote the growth and development of industry in the United States generally and in our territory in particular, and a favorable attitude toward the company by our customers."

To implement the policy, the statement says, "We send inquiries only to domestic companies. We advise the representatives of foreign companies who call on us that it is our policy to buy American."

But the statement makes it clear that foreign purchases may be made "in exceptional cases." Typical of such cases would be: (1) Items not manufactured domestically; (2) Items not currently available from the domestic market; (3) Items for which there is inadequate domestic competition. CEI has made foreign purchases during the past few years under each of these exceptions, but the precise weight given various factors in arriving at a decision to buy from a foreign supplier is not spelled out. However the statement does say, "The Purchasing Department should be consulted on all considerations of foreign purchases whether as outright purchases by our company or as components of other equipment which may be imported. This consultation should occur prior to any discussions with potential suppliers."

Initial response to the CEI statement was reported to be highly favorable. This came from suppliers who were informed of the policy. However, it was apparent that the real nub of the statement was exception 3—items for which there is inadequate domestic competition. How will CEI determine what is "inadequate domestic competition"? Would identical quotations be taken as a sign of inadequate competition? Will some price differential be set up as between foreign and domestic suppliers? These are the questions that are almost certain to be asked by other utilities and eventually by suppliers.

GOVERNMENT DECLINES TO RESTRICT FOREIGN BUYING

Also in the area of foreign purchases, the federal government has rejected a plea to restrict imports of large steam turbine-generators. The plea had been submitted by domestic manufacturers, led by General Electric Co and Westinghouse Electric Corp, and was aimed at government purchases of large foreign equipment. In its ruling, the Office of Civil and Defense Mobilization said that such imports are not threatening to impair national security by injuring domestic productive capacity needed for mobilization. OCDM Director Leo A. Hoegh said that relatively little procurement of these large units from foreign sources has transpired and that federal procurement does not now place heavy reliance on foreign equipment of this type. OCDM reported that only ten large steam turbine-generators have been ordered since 1951. In some instances "prices quoted by the American concerns were nearly 50% higher" than successful foreign bids, Hoegh said. He also found that "in the foreseeable future" no import threat appears likely, and that no "imbalance between foreign and domestic procurement" is indicated.

The manufacturers had based their plea on the so-called defense-essentiality clause of the Trade Agreements Act. The turn-down on steam equipment follows similar rejections by OCDM on other items of heavy equipment including hydroelectric turbine-generators, transformers, and circuit breakers.

The ruling applies only to purchases by the federal government and does not change the ordinary "Buy American" regulations which the government has applied in evaluating foreign bids.

PRICE HIKE IS SLATED FOR LINE POST INSULATORS

Price increase of 5% on line post insulators to take effect Dec. 12 has been announced by Lapp Insulator Co. The new price schedules will apply to both tie and clamp top, vertical and horizontal mounting, in voltage ratings 20 kv through 55 kv. The Lapp Co said the price of higher voltage posts are not being changed "since they compete with suspension insulators where prices are not fully firm." Prices of distribution posts are also unchanged.

TARIFF CHANGE ON ALUMINUM MIGHT SOFTEN DOMESTIC PRICE

Talk among aluminum producers of a possible price increase was at least temporarily sidetracked recently when the State Department indicated it was willing to consider bargaining for lower tariffs on primary aluminum. Present tariff is 1¼¢ per lb. Any reduction of the tariff would put pressure on domestic producers to hold prices at present levels or perhaps even trim them because of the inroads already being made by Canadian producers. From the government's viewpoint, the inclusion of aluminum on the list of tariff bargaining items was said to be aimed primarily at expanding trade with Canada. The big three US producers indicate they will fight the move at Tariff Commission hearings in January and may take their plea to Congress if aluminum is not removed from the offer list.

AERIAL BUCKETS OFFER ADVANTAGES IN SAFETY AND ECONOMY

Aerial buckets—the kind used to hoist linemen to poletops—have still to make their debut on many electric utility systems. A spot check by *Electrical World* at a regional transportation meeting this past summer indicated that less than half the 30 electric utilities represented were making use of aerial buckets either directly or through contractors.

Yet these devices appear to offer advantages in safety and economy. A Northeastern electric utility which is making use of aerial buckets recently offered this report: With the bucket trucks, two-men crews are doing the work of three to three and one-half men. Safety is plus on the side of the bucket truck. The hazards of falling and cutting out are reduced. The men experience less fatigue and have better working positions. The device makes the setting of ornamental street lighting poles easier. The potential hazards are too much dependence by the men on machinery and, if the power is misused, the chance that the man can run himself into something. In this particular utility, the emphasis has been on using the bucket truck as a regular line tool rather than as a specialty device. It will have 14 of the bucket trucks in operation by early next year.

Only one Unipost goes 9 places

With just one catalog number of O-B Unipost, you can build three different stacks with ratings of 650, 900, and 1300 kv BIL. These are adaptable to six popular operating voltages from 138 to 345 kv.

If you use stacking posts at two or even three voltages, you may be able to build and maintain all these posts with only one type of Unipost unit.

There are no specialized or single-purpose Uniposts. The identical unit is used in every stack position. Furthermore, in application, the units are highly interchangeable, as the foregoing example demonstrates. This is just one of many possible combinations in the complete Unipost series.

Major inventory savings are obvious. Less obvious, but equally valuable, is the lack of confusion in the warehouse and on the construction site. Simply give a man a Unipost - - it will fit anywhere!

Coupled with these savings and conveniences are worthwhile design improvements which O-B has incorporated in this new insulator.

Your O-B representative can give you the whole Unipost story - - can demonstrate many of its features with attractive, desk-size, scale models - - can equip you with complete catalog and application data. Get these facts before placing your next stacking post order.

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass (B) HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10015-H1

How to save money on arresters

How dependable is an intermediate class lightning arrester? Ask this about all kinds of arresters, and you should get all kinds of answers. Ask it about the Thorex Dynagap Type GP, and here are the facts.

ITEM: The present intermediate class Thorex Dynagap arrester materially exceeds industry-wide performance of *all* arresters up to the year 1957, regardless of class or price. This gives you a realistic measure of what this arrester can do for you, based on your own experience with the best available (including O-B) four years old or more.

ITEM: Current models of Thorex Type GP easily pass the ASA test for 65,000-ampere, high current, short duration withstand. Their performance under ASA duty cycle test is not only completely acceptable, but demonstrates a unique ability of the arrester to accomplish total arc extinction well in advance of the first current-zero condition of the 60-cycle wave. On the ASA low current, long duration durability test, the intermediate class Thorex arrester withstands 20 applications of 500 amperes for 2,000 microseconds. This is over three times standard requirements for *station* class, and is conducted in a compressed time period of only 1/10 that permitted by standards.

ITEM: According to current industry reports, IR discharge performance of the Type GP Thorex is within only a few per cent of that for station class. In view of the difference in duty between intermediate and station class, this indicates remarkable proficiency.

You have the proof - - and you can have the arrester for about half the cost of present station class equivalents. Especially on low-budget projects, Thorex Dynagap intermediate class Type GP arresters are ideal. They render a superior grade of equipment and service protection, at least equal to what was considered the very best when most of your stations were built. You can install them with confidence.

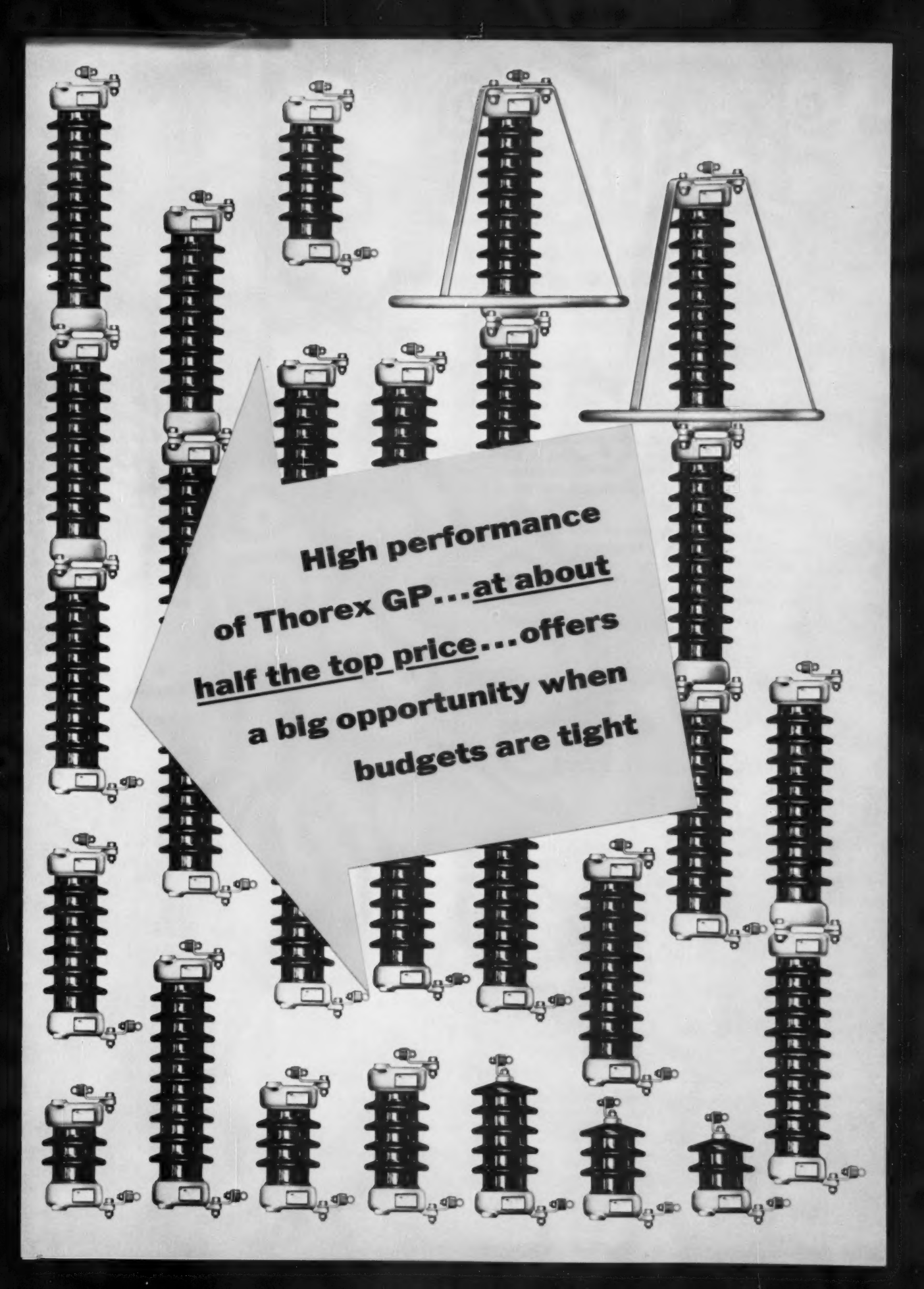
OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10015-H23


High performance
of Thorex GP...at about
half the top price...offers
a big opportunity when
budgets are tight

It's there... use it

O-B bushing design takes high strength of core and transmits it to the total structure

Wound paper and foil condenser cores of O-B Class GK oil-filled bushings are wrapped under tremendous pressure - - they're hard as an oak log, and as strong.

O-B bushing construction capitalizes on this strength. At numerous points below the flange, where mechanical duty is severe, the core and external parts are in contact. Strength of the core is transmitted to the bushing as a whole. Shocks of circuit breaker action are dealt with harmlessly. Permanent alignment is assured. Longer trouble-free life is inherent in such a design.

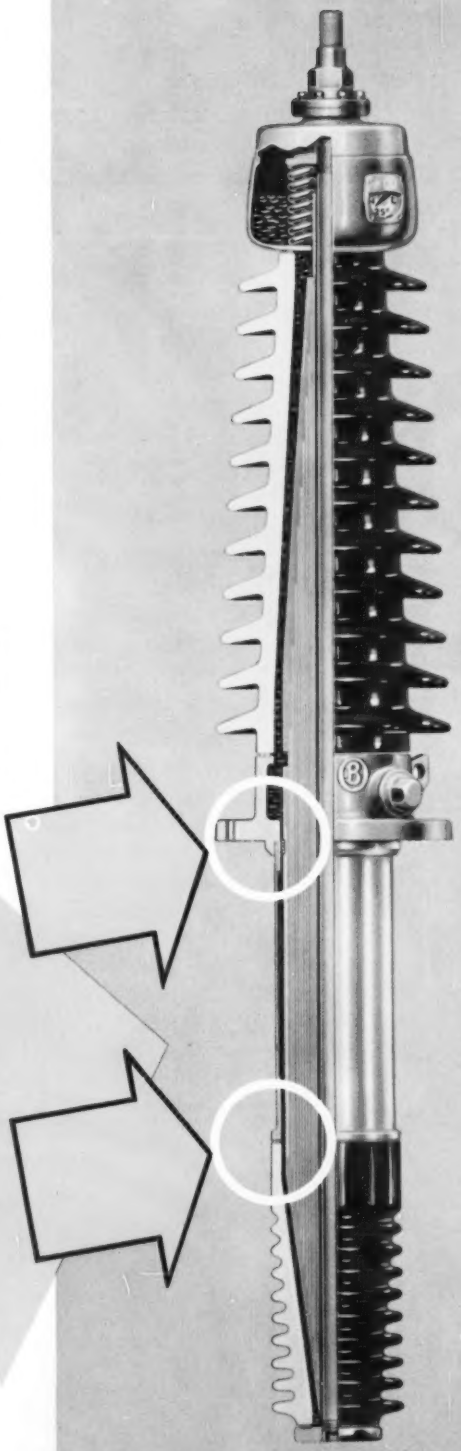
All it takes is expression of your choice to get O-B on new station apparatus. The strength that is naturally there is put to work for your permanent benefit. When you state a choice for O-B, you have stated the best choice. Performance proves it.

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co. Ltd., Niagara Falls, Ont.

Ohio Brass ® HOLAN

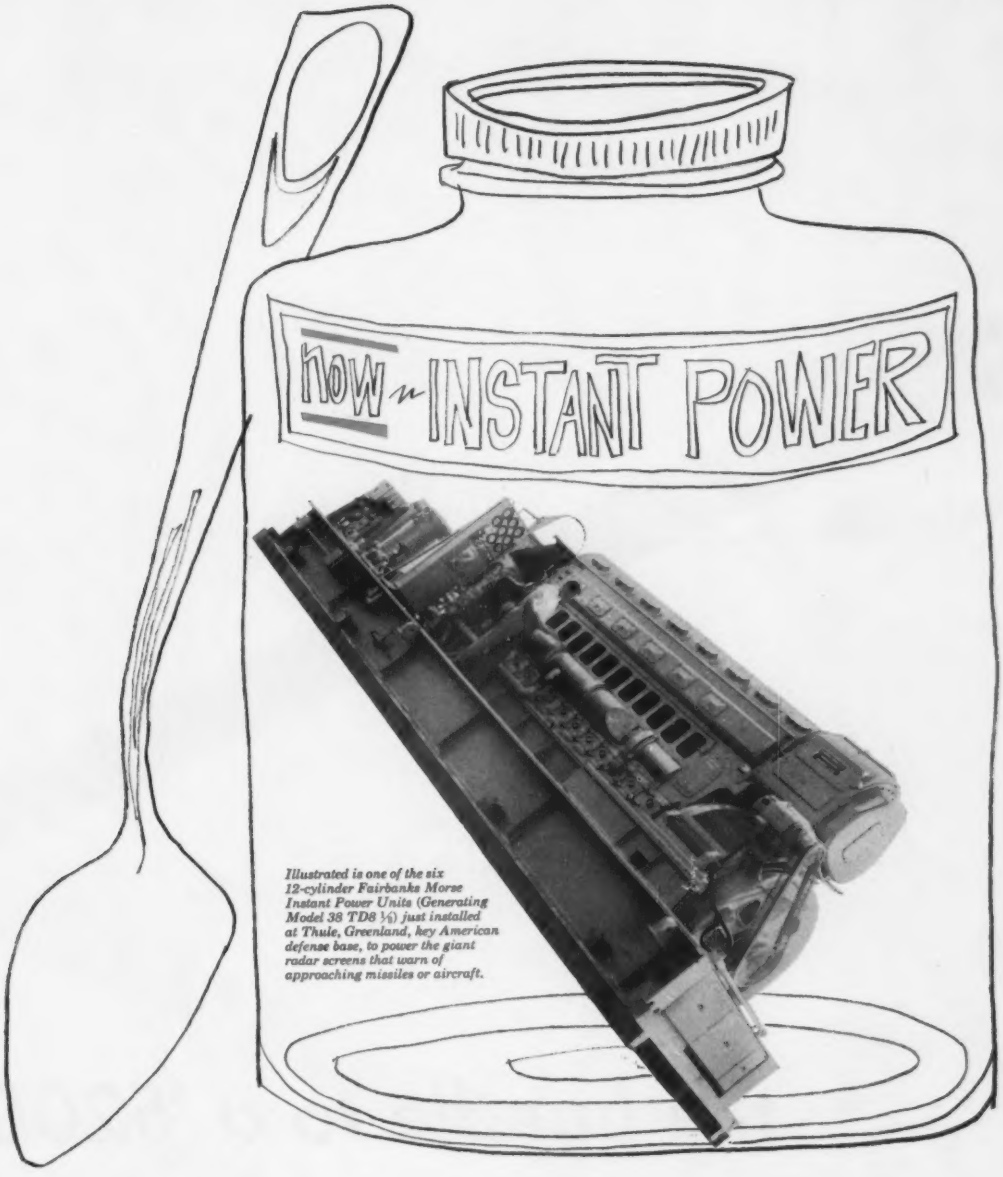
PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10015-H4



Multiple points of contact are made between core and external parts in these areas

These are interspersed with free oil passages as shown in illustration



Illustrated is one of the six 12-cylinder Fairbanks Morse Instant Power Units (Generating Model 38 TD8 ⅛) just installed at Thule, Greenland, key American defense base, to power the giant radar screens that warn of approaching missiles or aircraft.

This is the world's fastest-starting diesel generator—and the most economical

Advanced opposed-piston design—an exclusive Fairbanks Morse development—makes this Instant Power Unit the world's fastest, most economical standby!

Within 30 seconds, it hums to peak power! Full, vibrationless power! Automatically! Sturdy, self-contained, a complete generating package that delivers more kilowatts at less cost in less time than any other unit.

A model to meet every need. Automatic or manually controlled. Accessories to your specifications. For utilities and other vital services. Produces up to 2500 KW at 900 rpm. Can be linked in multiple units to supply any volume of power for peaking, standby duty, dead load pick up.

No faster, better protection at any price than a Fairbanks Morse Instant Power Unit.

For full details or custom specifications, write today to: Mr. S. K. Howard, Director of Marketing, Diesel Products, Beloit Division, Fairbanks Morse & Co., Beloit, Wisconsin.

Fairbanks Morse

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**

the handle to a $5200

Just one stroke of the handle stores the closing energy in the new and unique Federal Pacific 5 KV and 15 KV circuit breakers. By eliminating outside power sources, the new breakers cut installation costs up to $5200 on battery, cable and control requirements alone. And "stored energy" is *safe* energy with Federal Pacific breakers . . . even for inexperienced operators! Our exclusive foolproof interlock prevents actuation unless instrument door is *closed and locked*. Also available . . . electric motor charged "stored energy" breakers . . . for new economy and reliability in unattended installations.

saving!

Motor charged breakers can be manually operated in case of control power failure. This new line of breakers is just one more example of the outstanding products and ideas from Federal Pacific . . . famous for over fifty years of leadership in "stored energy" devices. For all the facts on Federal Pacific's complete line of "stored energy" circuit breakers, write for Bulletin 6045. Federal Pacific Electric Company, Department FP-2, Newark 1, New Jersey.

FEDERAL PACIFIC ELECTRIC COMPANY

FPE

growth through creative energy

From this modern new headquarters and manufacturing plant in Phoenix, Arizona General Electric *Announces...*

A VAST NEW EXPANSION IN COMPUTER FACILITIES

★ New Information Processing Center

■ New Sales Office

● Existing Sales Office

GENERAL ELECTRIC COMPUTER DEPARTMENT ADDING

11 NEW INFORMATION PROCESSING CENTERS AND 10 NEW SALES

OFFICES TO THE 16 SALES OFFICES NOW OPEN!

To better serve your computer needs, eleven new Information Processing Centers will be opened within the next year-and-one-half in addition to the two Information Processing Centers now operating in Arizona. Site surveys are proceeding in seven other key cities for additional processing centers. Ten new computer sales offices will be added to sixteen now open (General Electric presently operates offices in 350 key cities throughout the U.S.).

These vast expansions of facilities, manpower and actual operating computer systems are the direct result of customer confidence in the General Electric Company Computer Department and the great expansion of the computer industry as a whole.

General Electric's competence in the computer field is the product of 40 years' experience. General Electric provides computing and information processing systems for business, industry, science, engineering, education and defense.

If you are considering the application of a computer to your firm's operation, contact the existing Computer Department sales office nearest you or write directly to:

General Electric Company • Computer Dept. • 13436 North Black Canyon Highway • Phoenix, Arizona...today!

EXISTING SALES OFFICES:
Boston, Massachusetts
Chicago, Illinois
Cleveland, Ohio
Dallas, Texas
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Louisville, Kentucky
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Philadelphia, Pennsylvania
Phoenix, Arizona
Pittsfield, Massachusetts
San Francisco, California
Schenectady, New York
Seattle, Washington
St. Louis, Missouri
Syracuse, New York
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NEW SALES OFFICES:
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Cincinnati, Ohio
Columbus, Ohio
Denver, Colorado
Detroit, Michigan
Kansas City, Missouri
Minneapolis, Minnesota
New Orleans, Louisiana
Pittsburgh, Pennsylvania
Richmond, Virginia

NEW INFORMATION PROCESSING CENTERS:
Atlanta
Boston
Chicago
Cleveland
Dallas
Minneapolis
New York City
San Francisco Bay Area
Seattle
Philadelphia
Washington, D.C.

General Electric—Pioneer in computer systems for all phases of business, industrial, scientific, engineering and financial endeavor.

Nation's first MICR* Information Processing Center . . . with GE 210 computer system.

General Electric computers on test in modern manufacturing facilities.

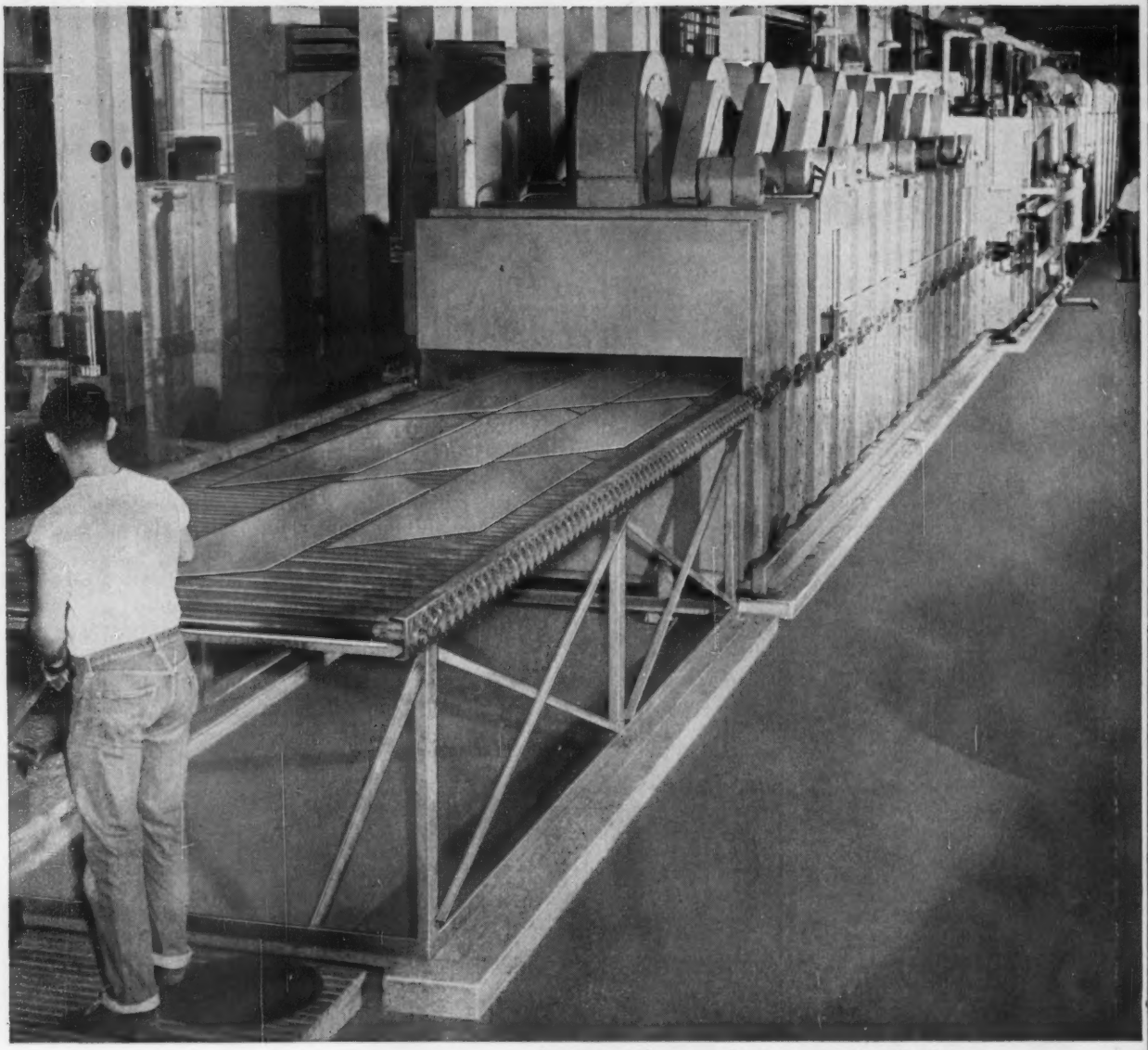
GE-312 control computer now operating in various industrial applications.

*Magnetic Ink Character Recognition

Progress Is Our Most Important Product

GENERAL ELECTRIC

CPA36 (10-60)

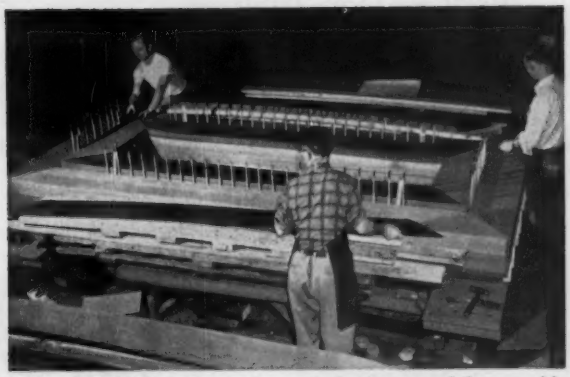


Lower core loss transtormers are built with the uniformly annealed laminations produced by this new furnace.

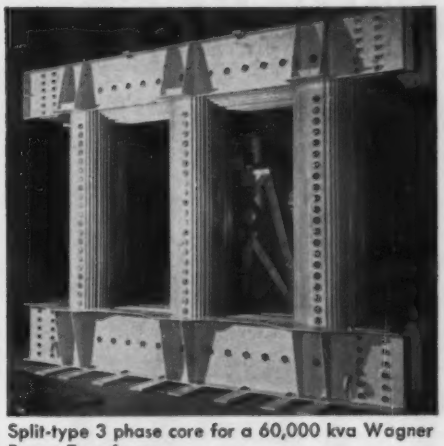
In Wagner's Transformer Plant...

A NEW ANNEALING FURNACE PRODUCES BETTER CORES FOR POWER TRANSFORMERS

Now, in every Wagner® Power Transformer, there's a new, compact core structure: mitered cores made of cold-rolled, grain oriented silicon steel that greatly reduce the across-the-grain component. Rolling follows the direction of the flux path... results in extremely low core losses and low exciting current.



Highly skilled Wagner transformer technicians carefully assemble core laminations after they come from the continuous annealing furnace.



Split-type 3 phase core for a 60,000 kva Wagner Power Transformer.

Continuous annealing of laminations enables us to make the most of these improvements in core steel and core design. Each individual lamination moves through automatically controlled heating and cooling chambers in our modern, continuous roller hearth furnace before being assembled into transformer cores that conform to the industry's highest standards.

This uniform annealing process relieves stresses so evenly that edge and ripple factor is extremely small. The annealed laminations are perfectly flat . . . practically free from stresses that affect magnetostriction and permeability. This flatter steel makes it possible to build tighter, more compact, virtually vibration-free core structures; minimum sound levels are achieved. And, the mitered core design substantially reduces across-the-grain losses and ampere-turn exciting current for peak electrical performance.

This new furnace, put into service a year ago, effectively cuts annealing time from days to minutes . . . produces highest quality, ready-to-use core materials at a rate that greatly reduces the time needed to manufacture finished transformers.

The performance stability of Wagner® Power Transformers is outstanding. But, this stability is just one part of the story . . . quality is designed and built into every part of each transformer by specialists with years of engineering and production experience. Why not consult us about your power transformer requirements? Your nearby Wagner Sales Engineer is at your service. Call him . . . or write us.

Mitered core construction greatly decreases across-the-grain component. Rolling follows direction of flux path.

Another quality Wagner Power Transformer begins its journey to the installation site.

WT60-13

Wagner Electric Corporation

6456 PLYMOUTH AVE., ST. LOUIS 33, MO.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ECONOMY NEVER CAME IN SUCH A CHOICE

NEW '61 FORD TRUCKS

New Falcon Pickup

Economy never had such style!

Meet the pickup that's priced* as much as $231 less than leading conventional pickups! It delivered over thirty miles per gallon in certified tests! Big six-foot box with low (25.2 in.) loading height! And now—a new 170 high-performance Six plus the 144 Economy Six engine!

619 new models!

All engineered with one idea in mind . . . economy! New one-piece cab-body design for Styleside Pickups! New "Big Six" power for 2-tonners! New Econoline models that pack bigger loads in three feet less truck length! All at prices that give you a flying start to long-term savings. On all 1961 Ford Trucks, each part, except tires and tubes, is now warranted by your dealer against defects in material and workmanship for 12 months or 12,000 miles, whichever occurs first. The warranty does not apply, of course, to normal maintenance service or to the replacement in normal maintenance of parts such as filters, spark plugs, wiper blades and ignition points.

New 4-Wheel Drive Pickups

Ford's low-priced 4 x 4 models have the getup and traction to go most anywhere . . . road or no road! You can choose from two modern engines—the gas-saving 135-hp Six or the 160-hp V-8 that gives extra power and smoothness with "six-like" economy.

New "Big Six" Engine

More power for America's savingest 2-tonners

Now . . . in a new, big 262-cu. in. Six, Ford gives you the power of big displacement, the durability of heavy-duty construction, plus the gas economy of 6-cylinder design! Available early 1961. New 2-ton toughness, too, with a stronger, heavier frame . . . new riding comfort with new, smoother acting springs . . . and a rugged true-truck front suspension that can give up to twice the tire life of "soft" car-type suspensions!

New Styleside Pickup

Leader in looks, loadspace and low costs!

Ford's 6½- and 8-foot bodies both offer greater loadspace for '61—as much as 16% more! New one-piece cab-body design on a longer wheelbase gives greater strength, new comfort! And look at these savings:

Save up to $157 on price*! Ford Styleside Pickups are priced below all other comparable pickups! Save up to $219 on gas! Ford Sixes beat all leading competitive sixes in certified tests—scored up to 27% more mpg. That figures out to $219 in 50,000 miles! Save up to $150 on tires! In certified tests of truck suspension systems, Ford front tires lasted up to twice as long. In 50,000 miles, that can add up to $150!

FORD TRUCKS COST LESS

YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" PROVES IT FOR SURE!

FORD DIVISION, *Ford Motor Company*

New Econoline

America's lowest-priced* pickup—bar none!

Meet a revolutionary new pickup that saves more ways than any truck you've known! Modern cab-forward design pares away over a thousand pounds of dead weight, yet you get as much payload capacity as standard ½-tonners! It's three feet shorter over-all, yet there's a big 7-ft. box with 73 cubic feet of loadspace! You get lively performance in a proven Falcon Six that delivered up to 40% better gas mileage in certified tests!

**Based on a comparison of latest available manufacturers' suggested retail delivered prices*

Boiler Feedwater Pump Motor Magic for Power Plant Engineers

Shown above are three E-M Straight-Up-Ventilated Squirrel-Cage Induction Motors driving boiler feedwater pumps at High Bridge Station, Northern States Power Company, St. Paul, Minnesota. Each motor is rated at 2500 hp, 3600 rpm,

Straight-Up Ventilation Gives

The space-saving secret is in the natural air-flow design of E-M's Straight-Up-Ventilated Motors.

With straight-up ventilation, each motor takes in cool, clean air from both sides near floor level, circulates it in and around all operating components. The warm air is then discharged *through the top* of the motor housing. Natural convection carries it up and away where it can't heat up adjacent motors.

Thus cross-circulation and recirculation are effectively halted. Each motor has its own exclusive "convection stack" which permits compact installation with cool operation.

But that's not all. There's more magic in these E-M Motors:

GREATER OPERATOR COMFORT. No more hot blasts at face level. Since heated air from the top discharge rises straight to the ceiling, the usual warm air buildup at operator level is eliminated.

QUIET OPERATION. Aerodynamically sloped stator blowers and labyrinth air passages are among the

2300 volts. O. W. Johnson, plant superintendent, and C. H. White, assistant plant superintendent, are discussing advantages of straight-up ventilation of machine at left. Air-flow is indicated by paper streamers temporarily attached to discharge louver.

You a Compact Installation!

acoustical control features which help to minimize windage noise. The motor is not dead silent . . . just remarkably hushed.

EASY MAINTENANCE. Access panels and bearing caps are easily removed by one man without use of crane or lifting device. Permits quick inspection of coils, stator core, bearings.

And, of course, you still get the same premium materials and hand-crafted construction that has made E-M quality famous for over 60 years.

See how the magic of E-M Straight-Up-Ventilated Motors can solve *your* boiler feedwater pump power problems. Call your nearby E-M Field Engineer and write to the factory for your copy of brochure No. 1134.

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13,
Minnesota

1300-TPA-2210

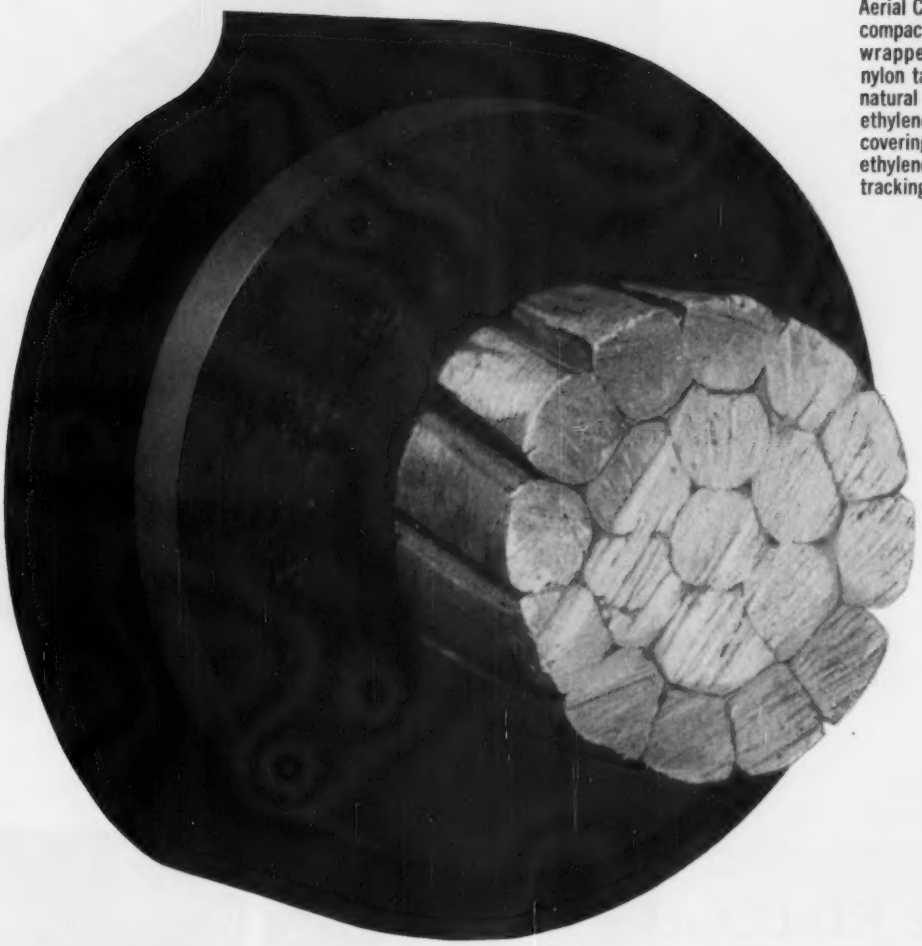
YEARS AHEAD IN FREQUENCY STABILITY

Precision frequency stabilization is a Collins tradition. In microwave systems, stabilization is achieved with the use of no-drift frequency reference cavities, regulated voltages and close klystron temperature control. With optional Automatic Frequency Control, tolerances are less than half the ±.05% FCC requirements and within the limits of new regulations effective in some bands in 1961. Interchangeable reference cavities are available at additional cost to achieve ±.005%. For details, write Collins Radio Company, Texas Division Sales, 1930 Hi-Line Drive, Dallas 7, Texas.

COLLINS MICROWAVE AND CARRIER

COLLINS

COLLINS RADIO COMPANY • DALLAS, TEXAS • CEDAR RAPIDS, IOWA • BURBANK, CALIFORNIA



Magnified section of Hendrix 24 Kv Aerial Cable (336,400 CM 19-strand, compact-round aluminum EC-H19) wrapped with semi-conducting nylon tape and covered with .175" natural high-molecular weight polyethylene. To this is bonded a .125" covering of new high-density polyethylene that positively resists tracking.

NEW! A Cable Covering That Solves High-Voltage Tracking Problems

NEW HIGH-VOLTAGE HENDRI-CLAMPS

TRI-7 HENDRI-CLAMP
Easy to use. Self washing. Spaces conductors 7" apart. Will accommodate conductor sizes thru 1,000,000 CM, max. O.D. 1.5".

15 Kv VERTICAL HENDRI-CLAMP
Features inside weather washing. Minimizes ice accumulation. Easy to install. Conductors are spaced approx. 6½" apart.

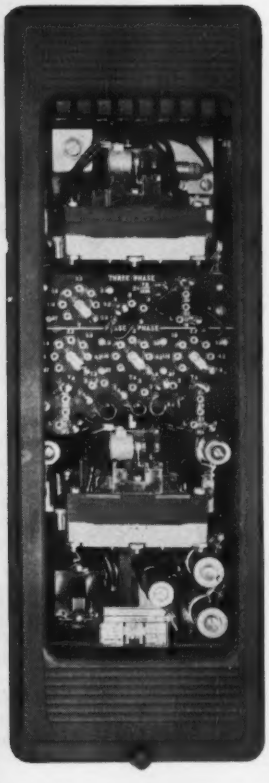
...and you get it only with Hendrix Aerial Cables

At last — a new polyethylene cable covering that prevents tracking at voltages above 9 Kv. Developed by Hendrix in cooperation with the technical service department of Union Carbide Plastics Co., Division of Union Carbide Corp., this remarkable new polymer covering has proved itself in exhaustive laboratory and field tests. Let us prove to you how this new covering ends the costly troubles that arise from tracking problems. Write us for free field demonstration.

Hendrix WIRE & CABLE Corp. MILFORD, N.H.

NEW

Westinghouse KD-CO relay system offers unmatched protection for subtransmission and distribution lines

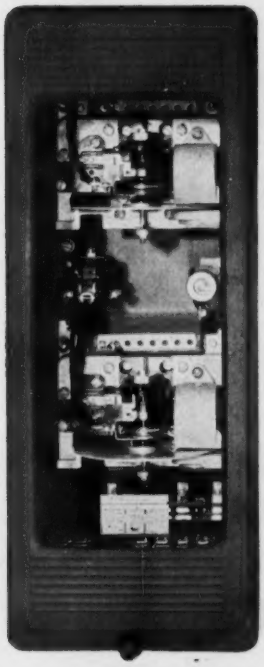


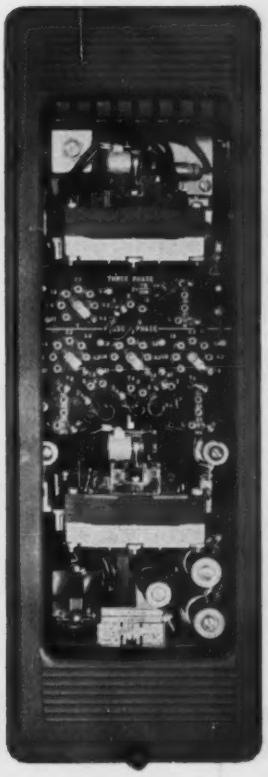
For the first time, this new Westinghouse relay system permits the exact fixing of the distance of overcurrent protection along the line and offers complete directional distance torque-control. Three standard Westinghouse Flexitest* cases enclose the whole scheme, neatly and compactly. You enjoy the assurance of dependable performance established by the famous semi-static K-Dar units. These are completely standard KD relays, used in conventional zone and carrier relay systems.

Call your Westinghouse sales engineer for more information about this new advance in protective relaying or write for RPL 60-14, Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. You can be sure . . . if it's Westinghouse. J-40534

*Trade-Mark

Two standard KD relay units and one two-unit CO timing relay comprise the complete package. Note how neatly and compactly they work together in standard Westinghouse Flexitest cases.

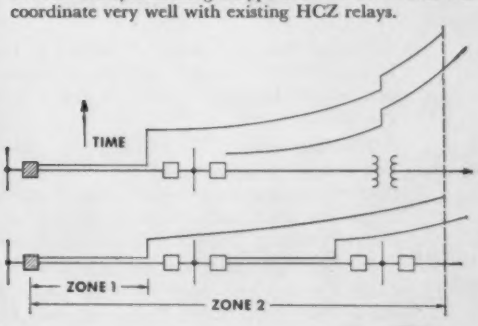




Here's how it works:

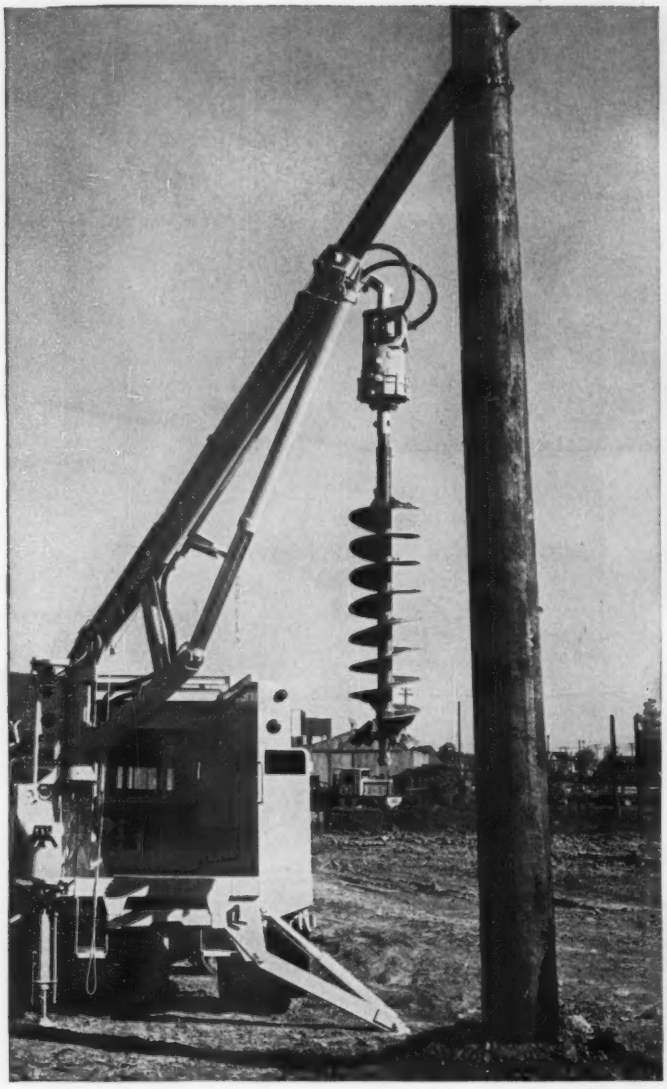
One KD is set for 90% of the line for instantaneous primary first zone protection. The other KD is set into or through the remote adjacent line for end zone primary and remote back-up protection. This KD is also used to torque-control the double-unit CO relay which is used as a timing relay for selective tripping. The overcurrent sensitivity can be set below load since its operation is controlled by the KD relay. The KD relays can be set into or through the transformer bank for full protection on either side of the bank.

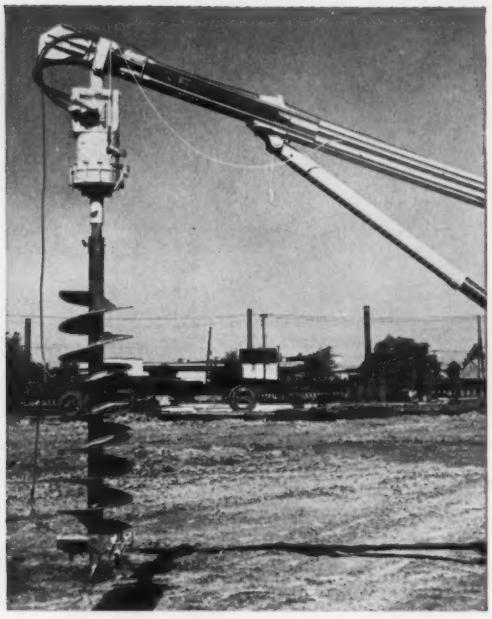
It's worth noting, too, that various overcurrent time characteristics can be used to coordinate with existing relays . . . Types CO, CR, HRZ or HCZ. For example, the KD-CO system using a Type CO-7 characteristic will coordinate very well with existing HCZ relays.



Typical application for two-zone KD relaying with two-unit torque-controlled Type CO relay for zone-two timing.

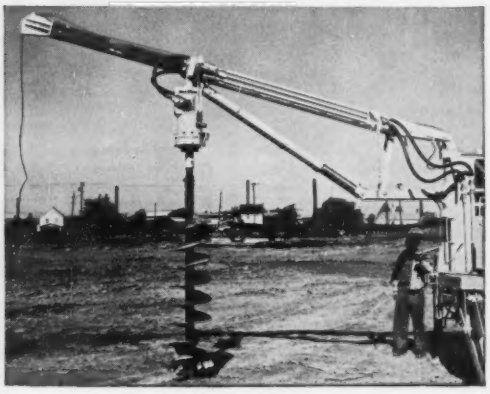
Westinghouse





Semi-automatic device locks borer on end of extendible boom for digging.

Borer automatically locks to end of main boom when retracted, leaving extendible boom free for pole setting.



Diagnosis: High Feed Pressure

Strongest corner-mounted derrick in the field is Holan's 7500 — a powerful, time-saving derrick that operates in an arc behind and to the right side of the truck.

Here's power . . . real power . . . all the up and down feed pressure needed to drive any derrick-suspended digger. And more than that, it's the only corner-mounted derrick built capable of handling Holan's rugged 3-speed 5400 Earth Borer.

Jobs can go ahead on schedule — even in alleys, narrow streets and congested areas because positioning problems are ended. Parked parallel to the curb, the 7500 swings over . . . even over fences and guard rails . . . reaches out . . . and digs deep holes, sets poles up to 70 feet in length.

The 7500 is engineered as a complete unit to avoid body and derrick stresses . . . can "live boom" 8,500 pounds, winch 10,000 pounds.

A semi-automatic locking device moves the earth borer onto the extendible boom for digging . . . or to its main boom storage position.

The 7500 . . . shown here mounted on the left side . . . is available mounted on the right side. It reaches up 27′-6″, 18½′ behind the truck, and beyond the right side 12′-3″ (left-side mount) and 16′-10″ (right-side mount) with boom extended.

Before you buy any corner-mounted derrick, write us — or call your Holan Field Representative — for complete details.

Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio
Plants in: Cleveland, Ohio; Griffin, Georgia; Phoenix, Arizona

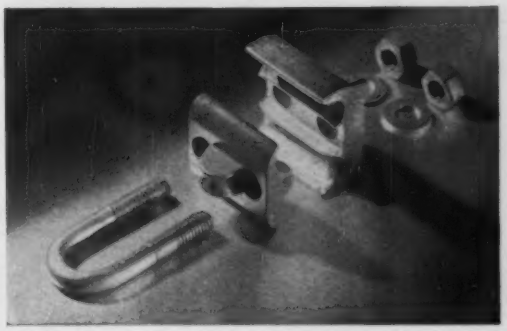
Holan

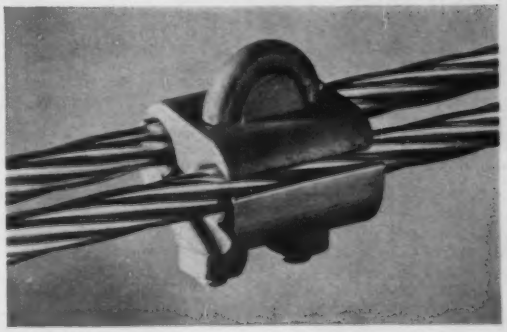
Subsidiary of THE OHIO BRASS COMPANY

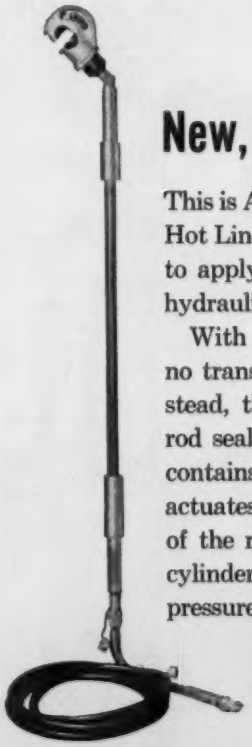
HOLAN

Real progress in dead-ending

Here is a new design in a deadend clip, referred to as Cat. 2412. The big advantage is the fact that it installs with ease. Note the construction and you'll see why. It's a simple but significant matter of the U-bolt position. There is no need to take the clip apart in order to install it. Thus, no difficulties encountered with loose parts and time needed for pole-top reassembly of clamp components. Doing the same job as Alcoa's older Cat. 412, these new clips—installed in a loop deadend—will develop 95% of the rated strength of the conductor. Single clips will develop 80% of the rated strength of ACSR and 90% of the rated strength of stranded aluminum conductor.







New, power-operated hot stick

This is Alcoa's new 12-ton-capacity 12 HA Hot Line Tool. It provides a sure, safe way to apply the labor-saving convenience of hydraulic power to hot line work.

With this hydraulic hot stick, there is no transfer of oil from pump to tool. Instead, thrust is obtained by a fiberglass rod sealed in a fiberglass tube. The tube contains no oil. Oil pressure from the pump actuates a cylinder on the lower (cold end) of the rod. This rod, in turn, actuates a cylinder at the upper end which provides pressure to the compressor cylinder. Oil pressure at the cold end is provided through standard hoses connected to either a hand or motor pump.

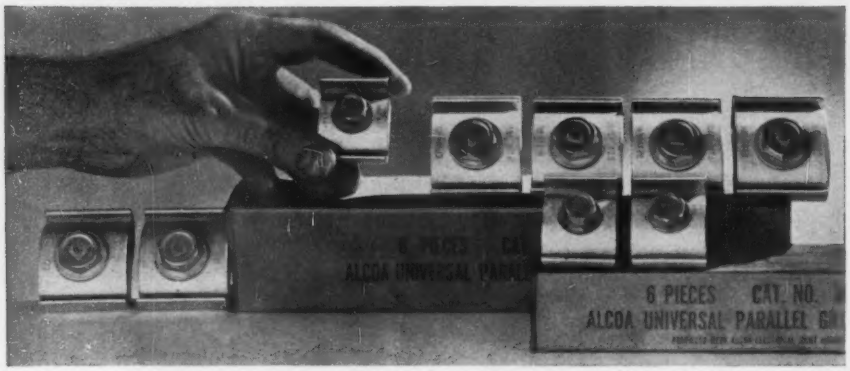
This tool has been thoroughly tested by cycling for leaks and under pressure overload. As an additional safety feature, the cylinders at the compressor end of the tool are covered with a phenolic housing, which extends from the quick coupler to the insulation.

Even in difficult operating positions, dies are always visible with this stick, since the head is placed at a 45° angle on the shaft. Over-all length is 7 feet 10 inches, with the insulated section 65 inches. The hot stick comes complete with quick couplers. More facts? Alcoa-Rome field advisors have demonstration models.

over ▶

Eliminates a mess

That's what Alcoa Filler Compound packaged in caulking tubes does. Designed for use with ACSR or stranded-aluminum compression accessories, it can be injected into joints or deadends by using any standard caulking gun. AFC performs the same function as zinc chromate paste with this important difference: *it is not messy to work with.* It won't splatter and stain. It will wipe from equipment and hands very easily. AFC also exhibits excellent temperature stability, staying greaselike and neither melting nor dripping from hot conductors. And it flows, even at 0° F. Complete directions for use are on the foil-labeled tube. Packaging is in cartons containing ten one-pound tubes. If preferred in bulk, there are one- and five-gallon cans.



Package with a purpose

Many parallel groove clamps prefilled with joint compound have been packaged in individual polyethylene bags.

However, there's one big problem with such a package. The loose fit allows the compound to smear not only over the inside of the bag, but *also* on the outside of the clamp. This means that some grease is lost from the groove, and the lineman, once he tears open the bag, has a messy clamp to handle.

Now Alcoa-Rome has a unique packaging approach. Six clamps in a row are packaged end-to-end in a cardboard container. This adds up to some good results.

FIRST: Clamps are easy to store, handle and count.

SECOND: Clamps are easily removed from the package in the field. Just slide them out one by one—no tearing or ripping of individual packages.

THIRD: Because the clamps are held in position relative to the package, grease from the prefilled grooves is not dispersed over the clamp surface. And, of course, there's no loss of joint compound from the groove, where it's needed.

Clamps are still packed in polyethylene bags for those who wish them that way. But we'd like to suggest that you give the improved Alcoa "6-pack" a try. Available in two sizes: Cat. 396.6 D and 392.6 D.

Summing up:

Alcoa's new Cat. 2412 deadend clip has greater convenience for loop-type deadends.

New hydraulic hot stick puts *power* to work on hot line.

AFC filler compound in caulking tubes makes neat, unspattered installations.

Parallel groove clamps are now available in a cardboard "6-pack" that helps eliminate messiness.

Your nearby Alcoa-Rome salesman is eager to supply additional information on any or all of these items. Why not call him today? For the name and address of our nearest representative, write to Rome Cable Division of Alcoa, Dept. AR-3, Rome, N.Y.

ROME CABLE
DIVISION OF **ALCOA**

This is an advertisement.

Single sideband system for power line carrier communications

By Roland U. Sandmeier, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

In many cases, power line carrier (PLC) is the lowest cost communication system for utilities and the most reliable. In addition, Brown Boveri's single sideband (SSB) equipment allows use of smallest bandwidth and offers flexibility to solve the most intricate communications problems. It is used in 32 countries on 5 continents with many extensive, complete power systems in Canada.

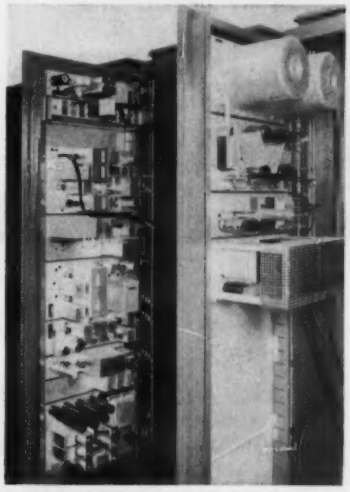
For voice, telemetering, remote control, protection relaying, teletype.

Several links may be connected in series without impairing the quality of either voice or superimposed control channels.

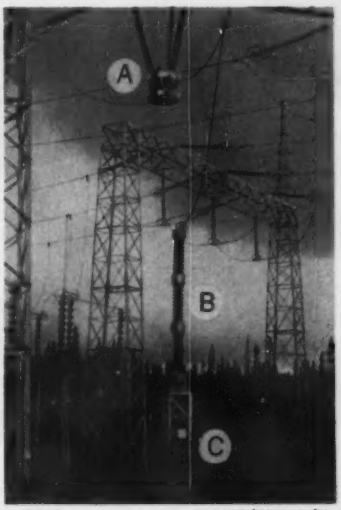
The system is as reliable as a modern telephone network. For example, the Swiss PLC network, extending over an area of only 10,000 sq. miles, consists of about 170 stations and uses over 360 Brown Boveri transmitter-receiver sets in a fully automatic dial system.

Simple, rugged equipment; high power output for long lines and high voltages.

PLC equipment uses relatively few tubes or transistors. Built-in tube checking devices simplify maintenance even by unskilled personnel.



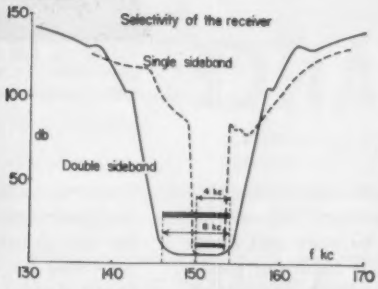
Left cabinet: Basic SSB set. Right cabinet: 100W power amplifier.



A—2000 amp wave trap. B—400 kV coupling capacitor and potential device. C—Protective device.

Twenty, 100 and, if necessary, 250 watt output is available to meet the most adverse conditions. Single-hop transmission over 350 miles on a 380 kV line carries voice and protection-relaying tripping signals with reserve power to overcome ice, rain, fog.

Broadband coupling with high-impedance line traps and high-capacity coupling capacitors gives balanced transmission conditions, allows repeated use of the same frequency. Line traps are available for currents up to 2000 amps and coupling capacitors for up to 460 kV. Line traps on all links and taps insure excellent transmission under all switching conditions.

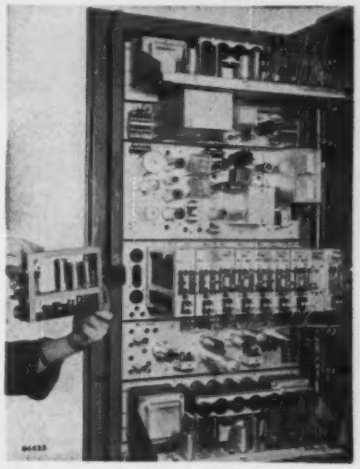


Single sideband allows adjacent transmitting and receiving channels.

Smallest bandwidth, adjacent channels.

SSB requires only half the bandwidth of either FM or DSB.

All signals (voice, telemetering, etc.) are carried by a 4 kc band; where channels are crowded, only 8 kc are needed for duplex communication with transmitting and receiving channels adjacent. Where voice only is required, bandwidth can be reduced to 2.5 kc for one direction and 5 kc for full duplex with adjacent channels. Rapid cyclic (time multiplex) telemetering, developed by Brown Boveri, handles up to 38 telemeter measurands on 400-cycle bandwidth . . . greatly expanding the capacity of an SSB channel.



Rapid-cyclic telemetering equipment. Receiver for 8 measurands.

Flexibility.

A 4 kc SSB link may be used for voice only, then adapted for as many as seven control channels without any change in basic equipment.

Best signal-to-noise ratio.

Presuming DSB carrier power is equal to SSB sideband power or total FM power, SSB is 6 db less sensitive to noise than DSB and 1.2 less than FM. Although the latter difference is small, SSB quality is much better than FM because of distortions in narrow band FM.

BROWN BOVERI Brown Boveri Corp., Dept. EW12, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities

PERFORMANCE

VICTOR No. 900 10" Suspension Insulators are the universal choice of power men . . . helping maintain continuity of service under the most rugged conditions.

Records of utility companies are best evidence of the performance of VICTOR Suspension insulators. This is the reason why VICTOR is being chosen by more and more power companies for whom the best is none too good.

Manufactured under rigid quality controls and tested with the industry's most modern test equipment, VICTOR Suspensions are something particularly special. They're designed right. They're made right. They perform right. Put 'em up today and chances are YOU won't ever replace 'em—they last that long. For catalog, specifications and prices contact VICTOR Insulators Division, I-T-E Circuit Breaker Company, Victor, N.Y.

I-T-E CIRCUIT BREAKER COMPANY

a New HIGH IN SAFETY AND RELIABILITY!

Only Square D's new combination starters give you all these advantages!

EXTRA SAFETY! • Operating handle permanently attached to switch—eliminates hazard of false handle indication. • Double protection against opening door with switch "ON." • Visible Blades on switch mean safety you can see. • Door must be completely closed before switch can be operated.

REAL RELIABILITY! • Really dust-tight—NEMA 5-12 construction keeps out dust and coolant • Door closes snugly every time—latches at both top and bottom to make tight seal. • Simple closing mechanism—no complicated linkages to get out of adjustment. • Rugged construction throughout for extra-long life.

SO SIMPLE TO USE! • Front operation makes ganging easy. • Plenty of wiring space—all through-wiring with line terminals at top, load terminals at bottom. • Fuse clip-spacing and sizes easily changed to simplify horsepower or voltage change.

Get the Complete Story on the newest, safest, most dependable combination starter available
Write Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin

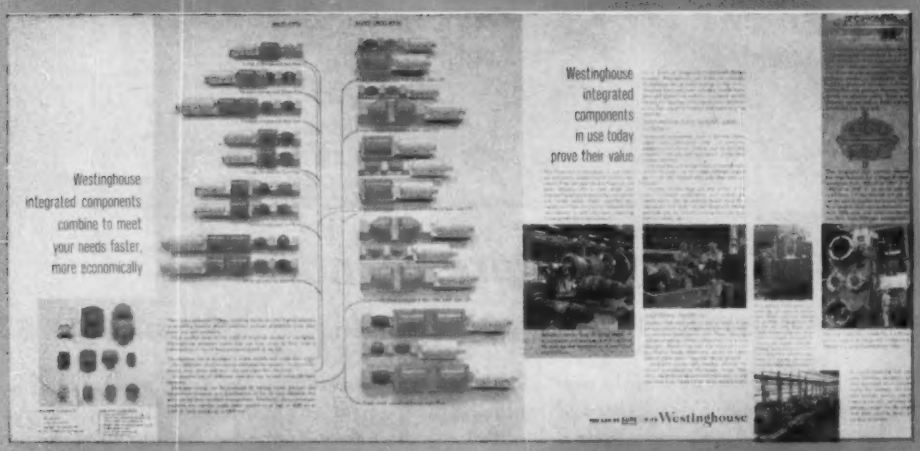
SQUARE D COMPANY

wherever electricity is distributed and controlled

generator research program leads to higher capacities, lower maintenance
full line of heat transfer apparatus permits best design for higher efficiencies at lowest cost
Westinghouse integrated turbine components promise economical superload growth

Some manufacturers say, "Our product is too big—only one reader in 100 has any real connection with buying one." But it just doesn't work that way. The bigger the price tag, the more men are involved... over a longer period of time. These readers are among the 26 who were interviewed about this Westinghouse ad. All 26 were interested.

Superintendent Power Station—Generation: "The ad reminded me of the Westinghouse qualified engineering facilities... It was colorful... a subject in my line of work." Results Engineer—Generation: "I had not known that Westinghouse was standardizing to such a degree. I would like to have more engineering details—I plan to discuss it with the company engineers." Power Station Supervisor—Generation: "I learned that generation equipment can be large and still efficient. I discussed it in the control room." District Manager—Top Management: "We do not need large units yet, but might at any time. I discussed the ad and referred it to someone." Chief Engineer—Generation: "The bigger units are new to me. I learned the sizes that were available." Engineer — Generation: "This triple-shaft cross-compound I had never seen before."

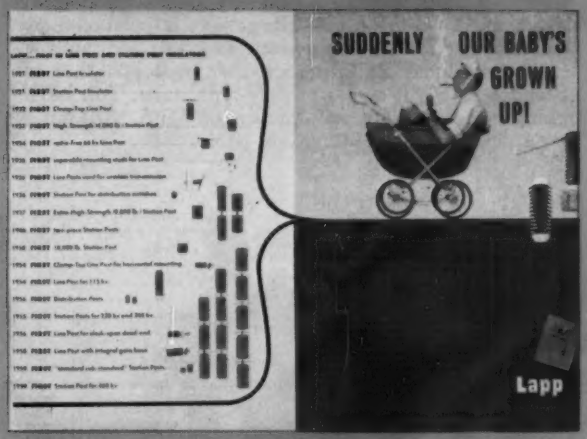

Westinghouse integrated components combine to meet your needs faster, more economically
Westinghouse integrated components in use today prove their value

How to save legwork for your salesmen

... as shown by verbatim comments from Mills Shepard "Penetration" studies of the March 21 and 28, 1960, issues of Electrical World.

★ **You've heard the comment, "Our salesmen and our literature reach all our good prospects." Moloney Electric Co. knows better. They ran this detailed product story to help spread the news about their transformer. Here are verbatim comments by readers:**

Senior Staff Engineer—Transmission and Distribution (T&D) Engineering: "The ad gave me some useful information. I referred it." Superintendent of Underground Survey—T&D Operation: "It gave me the six vital points of their transformer. I was told to read it and I was interested." Transmission Engineer—T&D Engineering: "I did not know they had used a computer to pick out the best design. I referred it to someone and plan to discuss it." Engineer—T&D Engineering: "It filled in some missing facts for me." Superintendent of Overhead Survey Engineering—T&D Engineering: "The ad gave a lot of information." Senior Engineer—T&D Engineering: "It gave me new knowledge." Layout Engineer—T&D Engineering: "It was the first time I had seen a complete description of this transformer... a good ad for information." Division Superintendent—T&D Operation: "Influenced my thinking in favor of it." Engineer—T&D Engineering: "I need this information for the course I am teaching."



★ **Then there's the one that goes, "All these smaller items are alike. Price is what makes the difference. You can't sell the quality story in an ad." Read these reader comments on a highly competitive, high-volume product.**

Electrical System Planning Engineer—Transmission and Distribution (T&D) Engineering: "If I needed an insulator, I would check with Lapp." Senior Estimator—T&D Operation: "They have a good insulator... one of the best. Some of the sizes are new to me." Engineering Supervisor of Substation—T&D Engineering: "It told me of the different insulators. I filed the ad." Engineer—T&D Engineering: "The most important part of the ad was on page forty, the different insulators they make. I made a mental note, discussed it and plan to refer it to someone." District Superintendent—T&D Operation: "Confirms my opinion that Lapp is first for insulators." Engineer—T&D Engineering: "Since they have improved their product, I think they will be the best for insulators." Operating and Testing Engineer—T&D Engineering: "I read that list... and I really was amazed by what Lapp has done."

Mills Shepard interviews show how ads give your salesmen more time to sell. They find prospects, search out real buying influences, keep customers posted on product lines. They keep prospects "warm" until your salesmen arrive... encourage others to call him in... *speed up your whole selling process.*

The electrical industry's weekly magazine

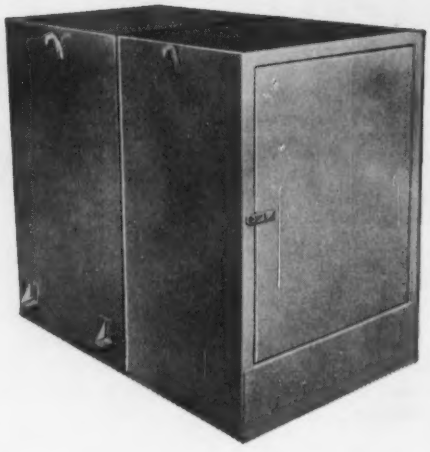
Electrical World 1st

Covers the electric power industry completely

in service to advertisers
service to the industry
reader preference
utility circulation
total circulation
advertiser acceptance

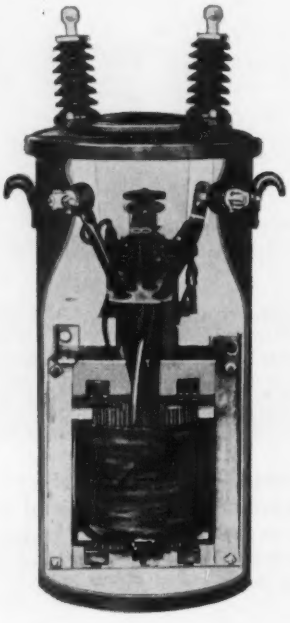
A McGraw-Hill Publication, 330 West 42nd Street, New York 36, N. Y.

SELECTING DISTRIBU



STANDARD'S FIELD TESTED, pad-mounted unit's compartmental design permits changes in single phase transformers without a change of terminations. Standard termination compartments give you complete flexibility from 15 KVA through 50 KVA and 75 KVA through 167 KVA. You change the transformer only . . . just as you do on a pole.

You can work on the secondary side with perfect safety because the high voltage side is protected by an inside door. Outside door is equipped with a hasp and lock. Performance data matches that of Standard's SWA series of pole-type units. You have complete flexibility on protection and switching equipment to meet individual preference.



EXCEPTIONAL PERFORMANCE by these SWA units has placed them on the approved lists of leading utility companies. Extremely low copper losses, low impedance and low temperature rise without excessive voltage drop put these units in a class by themselves. Your Standard representative can show you how they reduce "unaccounted for" losses on your system.

TION TRANSFORMERS

AREN'T THESE THE CONSIDERATIONS?

INCREASED VOLTAGE AT THE METER.
INCREASED OVERLOAD CAPACITY.
REDUCED COPPER LOSSES . . . and
SELLING MORE OF PRODUCED ENERGY?

Sure they are! But even more important, you have to ask yourself "What's best for MY system?"

Let's check the chart. A complete set of all ratings are yours for the asking. See how overload can be carried on the SWA without exceeding the 3% voltage drop danger line.

See how the copper loss compares with other transformers when you carry overloads.

Check the thermal time constant as a measure of overload capacity—SWA is 13 to 22% better.

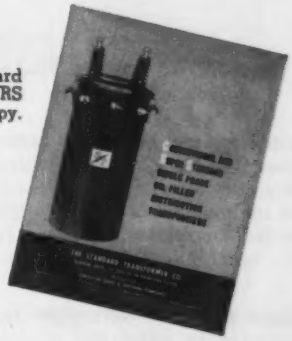
The Standard SWA series of pad-mounted and pole-type distribution transformers hits these problems hard. They slash copper losses a whopping 30% at full load to help you deliver more power to the meter . . . reduce impedance to cut service complaints . . . have low temperature rise without excessive voltage drop.

These dramatic units help you SELL MORE OF THE ENERGY YOU GENERATE OR BUY. Your nearby Standard Transformer Company representative can show you how to apply these units to your system for best results. Check it out today. Get the facts from him. You'll be away ahead where it counts most . . . IN INCREASED REVENUES!

50 KVA — 2400 V. — NO TAPS

CONVENTIONAL 50 KVA WA								STANDARD 50 KVA SWA							
LOAD KVA	CORE LOSS	COPPER LOSS	TOTAL LOSS	% REG. 0.9 PF	%IZ	%IR	%IX	LOAD KVA	CORE LOSS	COPPER LOSS	TOTAL LOSS	% REG. 0.9 PF	%IZ	%IR	%IX
40	"	367	537	1.45	1.68	.92	1.41	40	"	267	437	1.00	1.12	.67	.90
50	"	575	745	1.82	2.1	1.15	1.76	50	"	418	588	1.24	1.4	.83	1.12
60	"	828	998	2.18	2.52	1.38	2.11	60	"	602	772	1.49	1.68	1.01	1.35
70	"	1125	1295	2.54	2.94	1.61	2.46	70	"	820	990	1.74	1.96	1.17	1.57
75	"	1295	1465	2.72	3.16	1.73	2.64	75	"	940	1110	1.86	2.09	1.25	1.68
80	"	1470	1640	2.90	3.37	1.84	2.82	80	"	1070	1240	1.99	2.25	1.34	1.80
90	"	1865	2035	3.26	3.78	2.07	3.16	90	"	1355	1525	2.24	2.52	1.51	2.02
100	"	2300	2470	3.63	4.21	2.3	3.52	100	"	1675	1845	2.48	2.80	1.68	2.24
110	"	2770	2940	4.00	4.63	2.53	3.87	110	"	2020	2190	2.73	3.06	1.84	2.46
120	"	3300	3470	4.35	5.06	2.76	4.22	120	"	2400	2570	2.98	3.35	2.0	2.69

CONCISE FACTS on the complete line of Standard WA and SWA Distribution Transformers are YOURS FOR THE ASKING. Write today for your copy. Check the figures out on your system.



41 years of concentration on transformer design.

Standard Transformer CO.

WARREN, OHIO

Phone:
EXpress 2-1563

"WHEREVER THERE IS POWER"

From RCA The Most Trusted Name In Electronics

RCA 110 Electronic

Engineered to withstand the rigors of industrial environment...an ultra high-speed control system ...tailored to your exact needs

The RCA 110, an advanced solid state industrial computer, offers capabilities that range from simple automatic monitoring and recording to complete real-time computer control of complex industrial operations.

From its very concept, the RCA 110 was designed for continuously operating processes, and built for maximum effectiveness under the hardest industrial usage. It is housed in dust-tight heavy steel cabinets and air-cooled by internal heat exchangers to guard against contamination from outside atmosphere. The entire system is programmed so that it will continuously check itself. In the event of main power failure, the RCA 110 calls into action a "safe shutdown" sequence without loss of computer memory or instability to the controlled system. Wired-in priority interrupt helps make the RCA 110 the most efficient industrial computer offered anywhere.

Like all RCA Electronic Data Processing Systems, the "building-block" concept of the RCA 110 permits custom-assembly of the system according to your special requirements, and easy expansion as your needs demand.

For detailed information on the world's most advanced industrial control computer, ask your nearest representative of the Foxboro Company, or write —Industrial Computer Systems Dept., Electronic Data Processing Division, RADIO CORPORATION OF AMERICA, 21 Strathmore Road, Natick, Mass.

The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

6 REASONS WHY THE RCA 110 IS THE WORLD'S MOST

DESIGNED FOR FAIL-SAFE CONTINUOUS OPERATION even under the most exacting factory conditions. Dust-tight, heavy-duty all-steel enclosures are equipped with industrial heat exchangers for internal cooling to prevent contamination from outside atmosphere. Requires no false flooring or other special site preparations.

UNIQUE PRIORITY INTERRUPT FEATURE enables computer to automatically select the most urgent task from multiple demands. Operates on programmed priority basis, to avoid traffic jams and to handle emergency situations immediately. Result—programs are easier to write, memory space is conserved, and computer free time is automatically assigned to self-checking routines.

MAXIMUM SYSTEM ACCURACY IS SAFEGUARDED with low impedance, single path ground scheme—permits low level signals to be processed by computer, eliminating cross talk interference from main frame currents. Employs solid copper, 150 pound bus bar as integral part of grounding system.

HEAVY DUTY SOLID STATE POWER SUPPLY includes separate metering and adjustment of all DC voltages, automatic alarming of over-voltage, and circuit breaker protection against current overload. Motor driven control eliminates start-up shock and prolongs life of all components. Reserve capacities in power supply, plus priority interrupt routine, safeguard memory information, and safely shut down the computer in event of main power failure. Entire system sectioned and metered for high-speed, automatic check-out.

Industrial Computer System

EFFICIENT INDUSTRIAL COMPUTER

EASY MAINTENANCE EVEN DURING OPERATION—all circuits accessible from front in extendable drawers and hinged chassis. Industry's most complete maintenance panel permits manual check-out of complete system. Computer continues to operate with all drawers fully extended. Circuits are designed to perform at high temperatures—have built-in marginal testing, and an automatic alarm signals improper operating voltages.

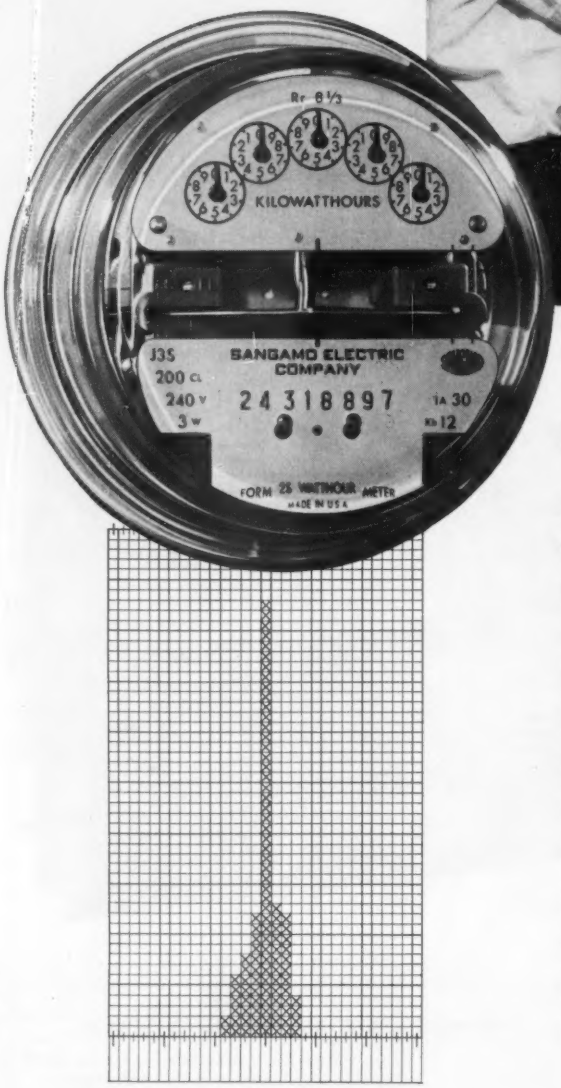
MODULAR DESIGN PERMITS FIELD EXPANDABILITY — both drum and core memories can be expanded in the field within a few hours as additional tasks are assigned to the computer or the number of inputs, outputs, and data manipulations are increased.

COMPARE THESE PERFORMANCE SPECS

Speed — including access time and staticizing, adds in 56 microseconds, multiplies in 728, divides in 868. *Instructions*—one address (limited two address), 7 indexable address registers, 71 wired-in instructions. *Number System*—fixed point, binary or binary coded decimal. 24 bit word length, word time 28.89 microseconds. *Working Storage*—magnetic core, coincident current, variable in size from 256 to 4096 words, 8 high-speed input-output registers, clock frequency 936 kilocycles. *Bulk Storage* — magnetic drum, 3600 rpm, 4096 to 51,200 words, 8.3 milliseconds average access time, 200 kilocycle transfer rate, up to 12 buffer tracks for input-output. *Size*—82" high, 34" deep, 105" long. *Typical Power Input*—5 kva, 220 volts.

true *MAGNETIC* flotation

J3 THE METER BUILT FOR SAMPLE TESTING



Utility meter departments employing sample acceptance and service tests can depend upon the good $\bar{x}$ and σ results of Sangamo's new J3 to assist in reducing operating costs.

tremendous teammates

Sangamo J3 meters and sample testing are tremendous teammates. The J3 was designed with sample testing in mind... Its original accuracy and dependability will remain constant for many, many years. This goal was achieved by combining J3 True Magnetic Flotation with highest torque, slowest speed, high surge resistance, and a balanced moving system to give calibration stability.

Successful acceptance and service sample testing programs require the high sustained accuracy and long term service dependability inherent in Sangamo's new J3 meter.

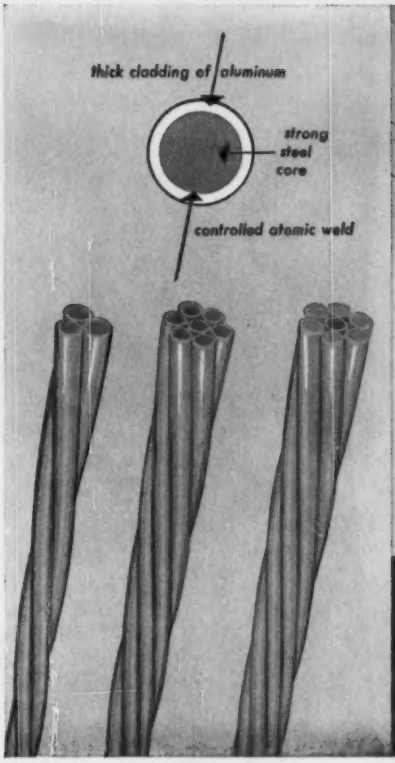
SANGAMO ELECTRIC COMPANY

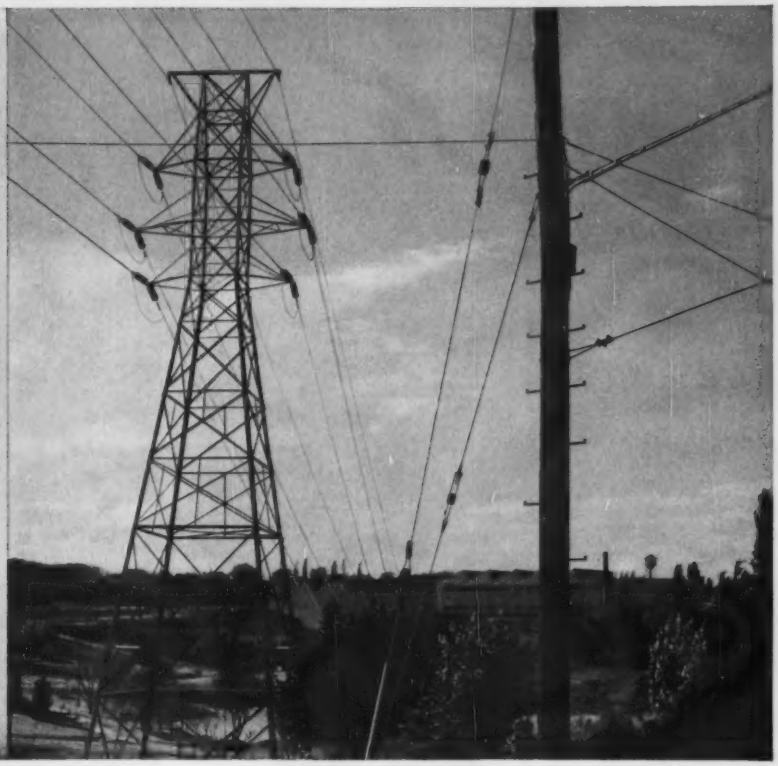
SPRINGFIELD, ILLINOIS

JM60-10

The Alumoweld technique *of welding aluminum to steel*

means TOP PERFORMANCE... LONG LIFE... LOW COST





● You cut costs and assure top performance of your overhead lines when you use Alumoweld for overhead ground wire, guys, messengers, and ACSR core wire ● You'll have no maintenance worries because a thick cladding of pure aluminum permanently protects Alumoweld's high-strength steel core from corrosion. In fact, Alumoweld has the same corrosion resistance as solid aluminum wire—and 33% of the electrical conductivity. Compared to steel, Alumoweld has three times the conductivity . . . is 18% lighter . . . just as strong . . . and will last far longer.

For overhead ground wire, Alumoweld is tops. The high strength-to-weight ratio permits stringing with smaller sags, thus increasing the mid-span clearance. Its excellent conductivity quickly discharges lightning currents to ground—reduces service interruptions.

For guys and messengers, Alumoweld gives long, trouble-free life because it cannot rust. And it's strong and easy to install.

For core wire in ACSR Conductors, Alumoweld eliminates the danger of electrolytic action because it is compatible with solid aluminum wires. It coordinates the life of the strength members with that of the conductor members.

Get all the facts on this low-cost wire and strand by writing today for bulletin E.D. 3000.

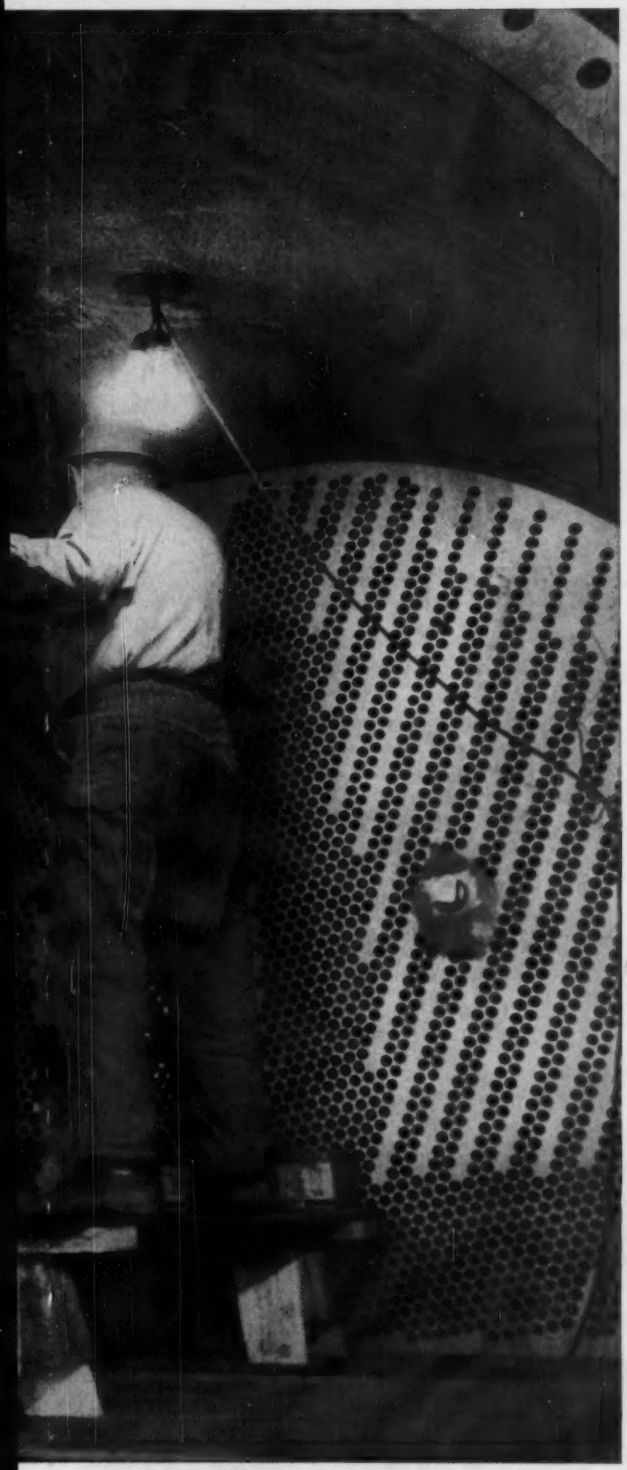
ALUMOWELD

COPPERWELD STEEL COMPANY

Don't tube up your condensers without calling Chase®

Unique Chase Condenser Tube Clinic

Provides Complete 8-Point Service



It's just plain common sense to talk to Chase first—before you order tube for original equipment or for retubing. Here's why: The Chase Tube Clinic has a special 8-point program that's ready to serve you in all these ways:

1. **WATER ANALYSIS** – either original or recheck, to help eliminate failure.
2. **TUBE FAILURE ANALYSIS**—by examination of sections of tube, determine why the failure and how to avoid repetition.
3. **CORROSION SERVICE**—predicts where to look for trouble based on the collected experience with water samples and service conditions from hundreds of areas all across the country.
4. **PRODUCT QUALITY CONTROL**—Chase tube meets rigid ASTM specs, and is given special Chase-developed electronic tests as well.
5. **WIDE ALLOY CHOICE**—Chase has the alloy available (brass, copper, aluminum, stainless or bimetal) to meet any combination of service conditions.
6. **STRATEGICALLY-LOCATED STOCKS** and mills can meet normal or emergency delivery schedules.
7. **APPLICATION ADVICE**—Chase tube engineering staff can help with design of tube sheets; welding or rolling-in installations; advice on use of inserts; selection of dual-gauge or thickened end tube, etc.
8. **PACKAGING TO SPECIFICATION**—When you order tube from Chase, it comes fully protected against damage, and in job-designed packaging to meet your exact specifications and installation needs.

Get in touch with the exclusive Chase Tube Clinic today—by calling your nearest Chase Representative, or by checking and mailing the coupon below.

Chase

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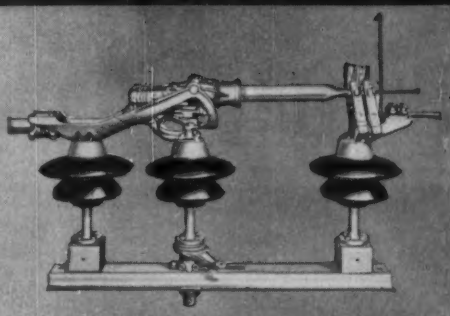

VERTICAL BREAK and side break switching equipment (34.5 kv) has silver-to-silver contacts, few current-interchange points, and excellent lever advantage for breaking ice or corrosion. Bearings lubricated with silicone grease sealed in for life with silicone cord rings which are not affected by weathering or contamination. A complete line of L-M switches for vertical and horizontal mounting is available. Oil-filled load interrupter attachment for 34.5 kv vertical break switch also available.

THREE-PHASE 20/34.5 KV TRANSFORMER POLE. Three 10 kva Round-Wound transformers with 150 kv BIL are shown with L-M Type SS 27 kv arresters and 27 kv Type HDO cutouts. All this L-M equipment was specifically designed for this service.

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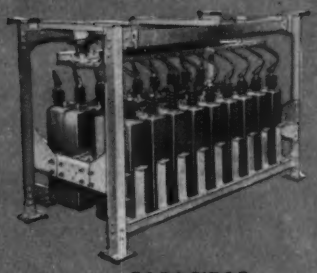
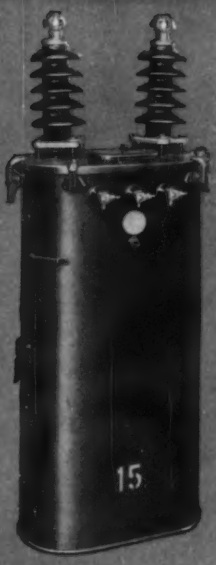
L-M'S 27 KV TYPE 3S distribution valve type arrester provides low-cost protection for 150 kv BIL apparatus.

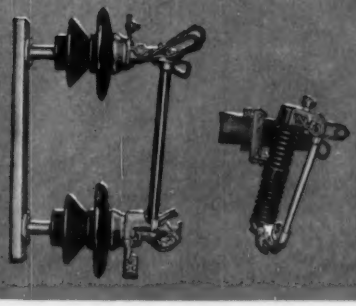


CAPACITOR EQUIPMENTS, blocks and banks to any size.

KYLE TYPE E RECLOSER, 23 kv, 150 kv BIL, in standard ratings, for single-phase extensions of the 20/34.5 system where the potential across the recloser will at no time exceed the maximum design voltage of 25.8 kv.



20 KV ROUND-WOUND® TRANSFORMER, specifically designed for this service, with 150 kv BIL, high overload capacity, low exciting current, and low losses.



TYPE HXO POWER FUSE (left) and Type HDO fuse cutout. The 27 kv, 100 ampere HDO has a rated interrupting capacity of 4000 amperes. The 38 kv, 200 ampere HXO has a rated interrupting capacity of 5000 amperes.

How 34.5 kv Distribution Cuts Costs... Here's Data on Methods, Materials

- Idaho Power Company pioneers 20/34.5 kv distribution, with ten years' experience.
- L-M pioneers, with research and development on apparatus, construction materials, and application for this economical distribution voltage.

by J. R. McDONALD, Field Engineer
Line Material Industries

Complete elimination of subtransmission, with fewer substations, higher feeder loading, and reduction of regulating equipment, resulting in lower cost per kva of installed capacity, appear to be among the major advantages afforded by 20/34.5 kv distribution, according to Idaho Power Company.

This progressive company now operates 275 pole line miles at this higher distribution voltage, and is expanding the system to serve additional farm customers. Idaho Power has found economical methods for conversion, and its experience is being generously offered to the industry. At the same time others, such as H. L. Hess of the Public Service Company of Indiana, Inc., have published the results of their studies.

L-M Provides Information, Apparatus

L-M has collected some of this data, and is offering a compilation, along with information on the apparatus and equipment L-M engineers have developed in working with Idaho Power Company and others.

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Ask your L-M Field Engineer for copies of papers L-M makes available on 20/34.5 kv distribution, or mail the coupon—and we will send them promptly—no obligation.

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Please send, free, copies of the following papers:

- ☐ 20/34.5 kv—An Economic Solution, by Don E. Haasch, Special Studies Engineer, Idaho Power Company
- ☐ 34.5 kv—A Possible Future Necessity, by H. L. Hess, Distribution Engineer, Public Service Company of Indiana, Inc.
- ☐ 20/34.5 kv Multi-grounded Wye Distribution System, by George W. Cooper, Line Material Industries
- ☐ Relative Merits of 20/34.5 kv Distribution by D. L. Andrews, Distribution Studies Engineer, Idaho Power Company
- ☐ The Long-Bus Substation, by D. L. Andrews, Distribution Studies Engineer, Idaho Power Company
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Close-up of Peltier thermoelectric device. Spring tension on the heat pumps automatically adjusts the device to different lamp bulb diameters. Can be used with any T12 through T17 lamp. L-M's Peltier device is presently available only for 6-foot, 4-lamp shallow luminaires.

This six-foot, four-lamp shallow luminaire utilizes four L-M Peltier thermoelectric heat pumps for spot-cooling the fluorescent lamps. In the heat pump, direct current flows through a series of junctions of dissimilar metals, alternately absorbing heat in one junction and liberating heat in the other. The cold junctions contact approximately one-half square inch on the lamp bulb walls thereby maintaining the mercury vapor pressure within the lamps at the optimum value for maximum light output.

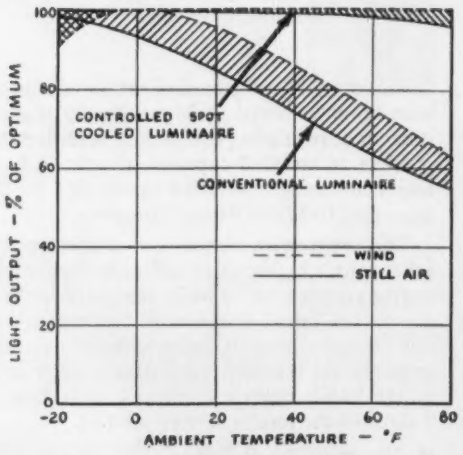
L-M's Revolutionary New Development Keeps Fluorescent Output at Maximum

by **STACY STANDLEY,**
Product Manager, Lighting
Line Material Industries

Now—Line Material develops another important engineering advance in outdoor lighting—Thermoelectrically Cooled Fluorescent Luminaires. These luminaires solve the basic problem of fluorescent lamp lumen output variation caused by ambient temperature changes. Another vital contribution by Line Material Industries to better outdoor lighting.

L-M Lighting Development Engineers have ingeniously adapted the Peltier thermoelectric principle to spot-cool fluorescent lamps. By the simple process of cooling a small area of each lamp, internal mercury pressure is held at the optimum and light output is maximized regardless of ambient temperature.

Be sure you get complete information on L-M's latest contribution. Contact your L-M Lighting Engineer, or write direct to Line Material Industries, Outdoor Lighting, Milwaukee 1, Wisconsin. In Canada: CLM Industries, McGraw-Edison (Canada) Limited, Toronto 13, Canada.



Performance curves of luminaires with and without controlled spot cooling: solid edge of band represents still-air conditions, dotted line represents 10 MPH of wind.

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Electrical World

DECEMBER 5, 1960

Editorial Comment

Enter the 'Turnkey'—What Does It Mean?

Texas Electric Service Co and Oklahoma Gas & Electric Co recently have galvanized the industry with awards of "turnkey" contracts to apparatus manufacturers for complete additions to generating stations.

Seldom have events set off so much comment, been so misunderstood and misinterpreted, and held so many implications.

It is too early to assay the effect on the industry as a whole of the "turnkey" approach to engineering and procuring of generating capability. It *is* certain, however, that if these events signal a trend, many relationships will be altered, some of them significantly.

TESCo is hailing its new 350-Mw tandem unit and associated plant design as a new "standard" (see p 68). And the OG&E 234-Mw combined gas turbine-steam cycle design is certain to have far-reaching effects on future fossil-fuel plant engineering.

Without question, the TESCo design has innovations which do much to reduce the cost of generating plant. Whether the innovations would be accepted as standard by enough utilities to warrant off-the-shelf treatment, as proposed, remains to the future. In any event, the views of TESCo Pres J. B. Thomas in this issue make provocative and recommended reading.

We have several cautionary observations to make. First, it appears evident that the TESCo and OG&E awards require two entirely different considerations.

First, we do not believe that the short time between the OG&E award and the TESCo announcement *in itself* signals a trend to the "turnkey" approach. It must be kept in mind that the OG&E plant is a prototype, although full-size, of a cycle not yet proven in utility practice. Thus General Electric's acceptance of complete responsibility, to us, resembles various manufacturers' approaches to prototype nuclear plants. On the other hand, the TESCo contract, though including considerable design innovation, is basically for a "conventional" steam plant. Comparing the two, or trying to imply that between them they've established a pattern, could lead to erroneous conclusions.

Second, the extremely low price quoted by Westinghouse on the TESCo job (under $80 per kw on nameplate and under $70 per kw on peaking capability) must be assayed as much in the light of today's sharply competitive market as in the light of a fundamentally low-cost plant design, whether the design subsequently is made a standard or not.

We believe the industry has just begun to feel the controversy brewing over manufacturers' "turnkeys" and all that they portend. Certainly, more questions have been raised than have been answered. And there is too much smoke screening the issues to permit fair and complete appraisal at this time.

You'll be seeing much more in *Electrical World* on this subject.

Water Pollution Problems Studied

Need for conference is questioned by Congressmen who are sponsoring legislation aimed at correcting most problems

Stream pollution problems are being reviewed in detail this week at a three-day national conference on water pollution in Washington, D. C. Electric utilities' principal interest in the hearings will be the problem of "thermal pollution": that is, heating stream waters beyond the point where normal fish life and oxygenation can take place.

Is Conference Necessary?

The conference, however, is set against a political background. Rep John Blatnik (D-Minn.) plans to introduce his own version of a tough federal stream pollution measure when Congress convenes in January. Blatnik feels the national conference, called by the President, is academic since his House Public Works Subcommittee on Rivers and Harbors already has held three hearings on the subject.

Blatnik's proposed bill—similar to, but tougher than his previous bill (HR-3610)—will have the following provisions: **(1)** A boost from $50 to $100 million in federal construction grants for municipal sewage plants, **(2)** A $3 to $5-million boost for interstate pollution programs, **(3)** An increase in federal enforcement authority, **(4)** Creation of about six regional pollution laboratories, **(5)** The removal of pollution from the Public Health Service to a separate "federal Water Pollution Control Administration" within the Department of Health, Education & Welfare.

House Public Works Committee Chairman Charles Buckley (D-N.Y.) also has written Surgeon General Leroy Burney, head of PHS and conference chairman, that the hearings will be academic, and what's needed is federal action, not further conferences and delay. Buckley said present pollution knowledge already is adequate for action.

The conference (Dec. 12-14) was called for by Pres Eisenhower last February when he vetoed Blatnik's pollution bill (HR-3610). Eisenhower vetoed the bill because it called for a doubling of the amount of federal grants ($50 to $100 million) for municipal sewage treatment plants. Instead, the President requested HE&W Secretary Arthur S. Flemming to arrange a national conference on water pollution: "This conference will help local taxpayers and business concerns to realize the obligation they have to prevent pollution . . ."

Edison Electric Institute is represented at the conference by L. W. Cadwallader, vice president and mechanical engineer for Potomac Electric Power Co. He also is a member of the 35-man conference steering committee.

Cadwallader says neither his company nor EEI will present any views at the conference; he and other utility leaders are present mostly just to listen.

"There's a great deal of information lacking" in this field, he points out. There's been no coordinated study of the problem by any national association or groups of utilities, although many companies have studied the problem from their own particular standpoint. The wide variety in stream flows, water temperatures and fish life has helped to keep thermal pollution reduced to an individual company problem.

The problem of thermal pollution hasn't been fully explored at either the national or state levels, and the limits on heating of stream water haven't been determined. The federal government has no regulation on the subject, and only a handful of states have attempted to legislate the problem. There's even a feeling among some experts that the heating of water during winter months may actually be beneficial to fish.

PHS reported to Sen Robert S. Kerr's Water Resource Committee:

"Since the amount of oxygen which water can hold in solution diminishes with increasing temperature, the introduction of heat in any substantial quantities into such water has the net effect of introducing additional pollution, because the ability of these water bodies to assimilate oxygen-demanding pollution, or to support fish life, is thereby reduced.

"Electric power generation has been almost doubling in capacity every ten years," PHS adds. "Projected to year 2000, this could mean at least a tenfold increase in power capacity. Allowing for improvements in the efficiency of the newer plants, this would still mean somewhere around an eightfold increase in thermal pollution. In the case of the Illinois River, the effects of thermal pollution introduced by steam-electric plants is reported to be equivalent to the doubling of the organic waste load which the river now receives from the Chicago area."

Sports fishing also is being jeopardized, PHS says: "Many of the country's trout streams are approaching borderline temperatures. A rise of only two or three degrees is sometimes sufficient to eliminate trout altogether."

Some States Have Acted

This two-degree temperature increase almost became the legal limit in Pennsylvania several years ago, but it was defeated. The state now is working on a new thermal pollution law. Maryland, on the other hand, limits industrial water heating to a maximum stream temperature of 100F 50 ft below the point of discharge.

Actually, thermal pollution is only a small part of the PHS conference. Most of the conference will discuss municipal and industrial chemical and sanitary pollution. PHS estimates construction of 6,000 new projects is needed.

The conference also is getting **(1)** Effects of pollution, **(2)** How pollution control can increase available water supplies, **(3)** Responsibilities of various governmental levels, **(4)** Research and training needs.

The conference also is getting some publicity through naming of John Daly, American Broadcasting Co vice president, as moderator of a special opening discussion by Sens Francis Case (R-S.D.), Kerr (D-Okla.), and Reps William Cramer (R-Fla.) and Blatnik.

Senate Committee Calls Landis, Prettyman

An organizing committee set up by President Eisenhower last September to study federal regulatory agencies has come up with its first recommendation, covering the size of a proposed watchdog group (EW, Sept. 18, p 88).

The committee, headed by Judge E. Barrett Prettyman of the US Court of Appeals, suggested that the watchdog group, which would be known formally as the President's Conference on Administrative Procedures, be composed of 65 members—40 from within the government and 25 from among attorneys and scholars outside the government who are experts on administrative law. The committee now is working on bylaws for the conference.

Kennedy is having his own study made by James M. Landis (EW, Nov. 21, page 63).

Landis sent a representative to last week's meeting of the Prettyman committee, but so far has not committed himself on the formation of an administrative conference. He is known to be generally sympathetic to the idea.

But there is some indication that as far as coordinating and streamlining agency procedures is concerned, Landis would rather have this job performed by strengthening the Office of Administrative Procedure which already exists in the Justice Department.

A Senate subcommittee on administrative practice and procedure, headed by Sen John A. Carroll (D-Colo.), called both Landis and Prettyman as witnesses recently.

Carroll said the subcommittee was particularly interested in the question of "the extent to which the commissions should be independent of executive control, the extent of control which should be exercised by Congress and the manner in which Congress should exercise that control."

Landis has expressed the view that "the broad policy pursued by the agencies should fall in line with that of the administration as a whole."

Dresden Out of Service For Control Rod Repairs

Dresden nuclear power station will be out of service for several weeks to correct the problem involving a control rod operating mechanism, Commonwealth Edison reports after closer analysis of the break in a control rod tube (EW, Nov. 28, p 16). Failure of the tube was due to stress corrosion cracking of the precipitation-hardened stainless steel used in the 12-ft drive tube.

No safety hazard was involved since a pre-planned procedure was followed to de-activate the faulty control rod.

After shutdown of the station on Nov. 15 following the failure, evidence of cracking was found on another control rod tube.

Corrections to the operating mechanism will be made by General Electric Co which designed and built the station.

Commonwealth Edison says that in other respects Dresden has operated even beyond the best expectations. They notified AEC that a full check will be made of the control rod mechanism and the results will be reported.

While the corrective work is being done, it is planned that all nuclear fuel in the reactor will be removed and put in the station's storage pits.

'Copter Totes 138-Kv Tower, H-Frames

Transmission line H-frames are taking to the air on the American Electric Power System these days in a project that may cut construction time for a 69-kv and 138-kv line by as much as one-third. Said to be the first time that helicopters have been used in all phases of line construction in the US, the project uses the "whirly bird" to haul all material from the marshalling areas to the construction site, pick up and set wood poles, and string conductors in lengths up to 10,000 ft. In addition, the helicopters have been used on an experimental basis to haul preassembled sections of steel towers and, in one case, to pick up and set a completely assembled 138-kv aluminum tower. According to Philip Sporn, president of AEP, the 'copter was able to deliver material for four towers, totalling about 20 tons, in about ten minutes per tower, with an average round trip of 3.5 miles.

NEMA to Push Business Development,

Reorganized manufacturers' trade association sets tasks, allocates funds for 1961. Among the major projects:

- **A stepped-up business development effort**
- **An educational program to present case for US firms**
- **Vigorous public relations program to win prestige**

Emerging from the throes of its broad internal reorganization program, the National Electrical Manufacturers Assn got down to serious business at recent meetings in Atlantic City and New York.

The 34-year-old trade association, acting at the board and divisional levels, charted tasks for the year ahead that included:

- A stepped-up business development effort, particularly in the areas of commercial and institutional wiring promotion, and industrial electrification.
- An educational and information program designed to combat the threats of foreign competition.
- A public relations program designed to aid makers of power equipment in winning prestige among customers and the public.
- A careful, studious effort to simplify and reduce expenditures for standards making.

In the series of meetings, the NEMA organization began to take form as eight streamlined divisions operating on a semi-decentralized basis and coordinated at the top level by the NEMA executive board. Formerly NEMA had operated with some 60 sections, most reporting directly to the board. It appears that the divisions will be looking to the board for guidance and to several special committees for aid and advice. Among the standing committees which report directly to the board are the public relations committee, the import committee, the codes and standards committee, and the industrial relations committee.

At the meeting of NEMA executives in New York, A. D. R. Fraser, president of the Rome Cable Division of Aluminum Co of America, was elected the new NEMA president. W. R. Persons, president of The Emerson Electrical Manufacturing Co, was elected vice president of the association, and A. E. Pringle II, president of The Pringle Electrical Manufacturing Co, was elected treasurer.

Decision to step up NEMA efforts in various business development activities was reinforced by a $40,000 increase in its budget, bringing proposed 1961 expenditures for various business development projects to $328,032. Most of the increase will go into the commercial and institutional wiring program. Under the banner of "Keep Pace Electrically," this project is aimed at encouraging closer cooperation among utilities, contractors, distributors and manufacturers to promote and sell modern wiring and lighting schemes to commercial and institutional establishments. The remaining part of the budget increase is to go as NEMA's contribution to the Industrial Electrification Council, which in the past has been sponsored by Edison Electric Institute and individual manufacturers. Beginning in January, the Council will be under joint EEI-NEMA sponsorship with NEMA sharing in its direction and financing.

The NEMA board approved quadrupling the association's budget allocation for keeping tabs on imports, tariffs, and trade agreements. This would bring proposed 1961 expenditures in this area to $41,725. While no specific project is outlined for a public education and information program, the NEMA budget report says, "There is need for public education on the impact of imports on the American economy, particularly among utilities and the electrical manufacturing industry's other customers and trade allies. A better understanding of the situation on the part of these groups will help to create a more favorable climate for the presentation of the position of the electrical manufacturing industry."

Two of the new NEMA divisions —Wire & Cable, and Generation, Transmission & Distribution—also singled out import matters for special attention. The GT&D group

OFFICERS OF NEMA'S GT&D DIVISION are Chairman C. H. Bartlett (right) of Westinghouse, and Vice Chairman L. W. Long (left) of Allis-Chalmers

Fight Imports

intends to work with the import committee in an activity aimed at broad education of industrial, commercial, and financial people concerning the effect of imports on the American economy. The Wire & Cable group has hired a full-time consultant and retained a Washington law firm to collect information and keep tabs on legislation and administrative action bearing on tariffs and imports.

While NEMA has allocated about the same amount for 1961 as for the present year for public relations activities, at least one of these activities is to be brought into sharper focus. The GT&D division voiced approval of a public relations program designed to increase the prestige of makers of power-producing equipment. While there was no mention of it in NEMA statements, it appeared that manufacturers of electric utility equipment were worried about the effect of the antitrust indictments then pending against more than a score of companies. The public relations effort would be aimed at overcoming any ill effects of the antitrust actions.

The GT&D division has set up its own public relations committee, headed by R. B. Reid of General Electric Co. This committee will work closely with the NEMA public relations committee in organizing and carrying out its information program.

In a move aimed at simplifying and cutting the red tape in the standards-making procedure, the NEMA Codes and Standards Committee recommended that all standardization activities be centered in the American Standards Assn sectional committees. NEMA sections would continue to share in the standards-making procedure, retaining responsibilities for review and recommendation. The GT&D division created a standards coordinating committee, headed by Fred Bush of the Allis-Chalmers Manufacturing Co, to coordinate the thinking and development of standards with other standards-making bodies. Bush's group will not take over the various sections' responsibilities in this area, but will assist sections in their work.

In a related move, the GT&D group also approved an information activity which would be designed to present the importance of equipment standardization to utility men.

The Consumers Product division reported that it had organized a parts and service committee to work to improve the appliance service problem with an eye to offsetting unfavorable publicity in this particular area.

The Wire & Cable division reported that it is working on various technical handbooks which will be made available to its members for utility and other customers.

METZ LINCOLN MACDONALD MORSS

NEMA Members Win James H. McGraw Awards

James H. McGraw awards were presented to three electrical manufacturers at a recent luncheon meeting of the National Electrical Manufacturers Assn. The honors went to:

N. J. MacDonald, president of The Thomas & Betts Co and also immediate past president of NEMA, for "his dynamic personal leadership dedicated to the coordination of the efforts of all branches of the electrical industry toward common objectives in the spirit of industry interdependence and service to the public."

Everett Morss, president of Simplex Wire and Cable Co, for "his initiative and dedicated industry leadership in the development of modern synthetic insulations for electrical conductors to the great benefit of the electrical industry."

J. F. Lincoln, board chairman of the Lincoln Electric Co, for "his dedicated and creative leadership in developing the electric welding process and in fostering its extensive and beneficial application. . . ."

The awards were presented by A. F. Metz, a member of the awards committee and former chief executive of The Okonite Co.

A bronze medal and a purse of $100 go with each award. This series of awards was created in 1925 by the late James H. McGraw, former president of the McGraw-Hill Publishing Co.

NEW NEMA PRESIDENT is A. D. R. Fraser, president, Rome Cable Div

Texas Electric Sees Low Costs as Major 'Turnkey' Incentive

Philosophy aims for large, minimum cost plants with reductions in space and piping

J. B. THOMAS, TESCO PRESIDENT, and R. C. Mason, Westinghouse, examine model of plant addition. Boiler is not shown

A 350-Mw (400-Mw peaking capability) addition to Handley Station of Texas Electric Service Co is being proposed as a standard unit to achieve design and erection economies through repetitive manufacturing techniques. J. B. Thomas, president and general manager of TESCo, announced that a contract for the complete plant addition will be given to Westinghouse Electric Corp (EW, Nov. 14, p 54).

"There is no doubt," Thomas states, "that a steam electric generating plant or unit addition is susceptible of being designed and manufactured repetitively as a unit. There is opportunity for individual designers and manufacturers of components and facilities to take their part in such a venture through manufacturers equipped to take full responsibility for the entire unit. The objective of such a venture is to meet world competition by repetitive manufacture of standard generating units that afford significant saving to the users and a reasonable profit to domestic manufacturers.

"Design of the 350-Mw unit is based on more than a year's study aimed at bringing out the possibilities that such large units afford for substantial simplification in design and substantially lowered costs. Every effort was made to have this design such that a very large part of it could be built, assembled, and fitted on a factory floor under unified direction and responsibility.

"The total cost to TESCo of this outdoor, gas-fired plant addition will be less than $80 per kw based on the 350-Mw rating," Thomas emphasizes. Equally favorable total costs would result for a new plant, he said.

"The decision to go ahead on such a course was made in late 1959. Three US manufacturers of large generating units were asked to join in the attack on the problem. Their cooperation was in all cases prompt and hearty. In addition to working with the company's staff and its consulting engineers, each manufacturer arranged for the cooperation of a different firm of engineers expert in plant design. Construction plans were outlined; models were built in all cases.

"The attack on the problems covered four principal areas:

1. "A unit size was chosen by Texas Electric which might be a good average standard unit for the next five years. Thus, the resulting benefits might be available for future TESCo plants and for repetitive manufacture for the electric power industry as a whole. The unit chosen is a 350-Mw unit with a peaking capability of 400 Mw, to operate at 2,400-psi, 1,000/1,000F steam conditions.

"While natural gas is available for basic fuel at Handley Station, with oil as stand-by, the boilers and layout are to be arranged for conversion to coal or lignite if necessary. The plant will be completely outdoor. Lake water is available for cooling and provision is being made for rated output at 3½-in. back pressure and 95F cooling water. A tandem four-pass exhaust unit was specified.

2. "A full exploration was made to take advantage of the great size and strength of the elements of the new unit so as to permit arrangement of the various components and auxiliary equipment to save space, piping and wiring. Thus a low pedestal with split condensers will make for low cost and increased accessibility. The full-capacity boiler feed pump is to be driven from a turbine shaft extension from the high-pressure turbine and immediately accessible to the boiler feed lines. The extraction heaters will be located on or at the condensers.

"Valving will be simplified and lessened in extent. A step-up transformer close to the generators will reduce leads and complications.

3. "The doctrine was adopted that the place to manufacture such equipment was in a factory under unified responsibility. In contrast, at Texas Electric's new Graham

Award of a "turnkey" contract to an *apparatus manufacturer* for a complete addition to a generating station has set off a storm of comment.

The "less than $80 per kw" quoted Texas Electric Service Co by Westinghouse is responsible for much of the conversation (see Editorial Comment, p 63).

TESCo Pres J. B. Thomas has now proposed the 350-Mw unit and plant design as a "standard." His views on the transaction and its implications are of immense interest, so EW obtained this exclusive statement.

Generating Station, where a 240-Mw tandem unit now is going into service, over 160 different substantial groups or classes of equipment were purchased from 104 different manufacturers and, after design, were completely assembled in the field with available labor.

"The decision was made that one unit consisting of the entire turbine equipment and auxiliaries would be manufactured and assembled as far as practical in a single factory, including equipment procured by the seller from others. After the usual manufacturer's tests, the equipment will then be reassembled in the field with the least possible delay and interference. A similar unit was asked for the boiler. Two large manufacturers of this kind of equipment asked to be allowed to bid on a 'turnkey' basis on a complete plant addition, including the boiler. One of these was the successful bidder for the boiler section.

4. "The complete coordination of design, manufacture and erection under one responsibility put squarely upon the seller full responsibility for design, cost and performance of all equipment. Immediately, top engineering and research began to be directed to equipment to which the turbine manufacturer had paid little, if any, attention. For example, a full-capacity boiler feed pump on a turbine shaft, to be as reliable as a turbine without compromising the turbine performance, prompted careful consideration of design and of performance of similar pumps, however driven. Heaters, water purification, removal of gases and many other problems also took on a new cast.

As part of his statement, Thomas outlined the purchase agreement covering the new unit:

"Westinghouse Electric Corp agrees to design, furnish and erect complete all of the material and equipment and to guarantee the performance of the overall plant addition. The addition will cover the complete unit from the natural gas fuel line inlet to and including the step-up transformer.

Combined Design Effort

"The unit is to be constructed in accordance with general specifications prepared by Texas Electric's consulting engineers, Ebasco Services, Inc, and seller's proposal in conformity therewith. United Engineers & Constructors Inc are carrying out the detail design and the field construction for Westinghouse. Provisions are made for local purchase of field supplies.

"The seller shall be responsible for the design and performance of each and every piece of equipment and for the entire addition."

Dateline . . . Asotin, Wash. (*Continued from page 5*)

Here are some of the points stressed by WWP employees in personal talks with the voters:

- The absolute power of PUD commissioners.
- Once a PUD is established there is no way to abolish it.
- Greater tax contributions by WWP.
- WWP is regulated by the Washington State Public Service Commission, PUD's are not.

W. A. Lowry, residential sales supervisor at WWP, said many persons interviewed during the campaign were somewhat undecided but were receptive to the WWP approach when the issues were fully explained. In the door-to-door campaign, WWP employees sought to determine customer attitudes toward the company and then they explained the PUD proposal and what it could do to residents of the county.

An improvement program for WWP's Clarkston water system had been underway last summer when a prolonged heat wave caused temporary water shortages. The Asotin County Water Users' Assn was formed in August by a group of residents who expressed concern over the water situation in the community. Later, some of the members of the association circulated petitions to place the PUD proposal on the ballot in the November general election.

PUD-backers then called in Gus Norwood, executive secretary of the Northwest Public Power Assn, to explain the organization and operation of a public utility district at a meeting in Clarkston. He outlined the experience of several other PUD's of the state in reducing power rates over a period of years. The PUD-backers largely based their campaign on what they considered the advantages of electric service by PUDs and there was little mention of the Clarkston water system. There had been no complaints about WWP's electric service.

It was the third time a PUD proposal had been voted down in Asotin County and it was the first time since 1955 that a Washington county had voted on the public vs private power issue.

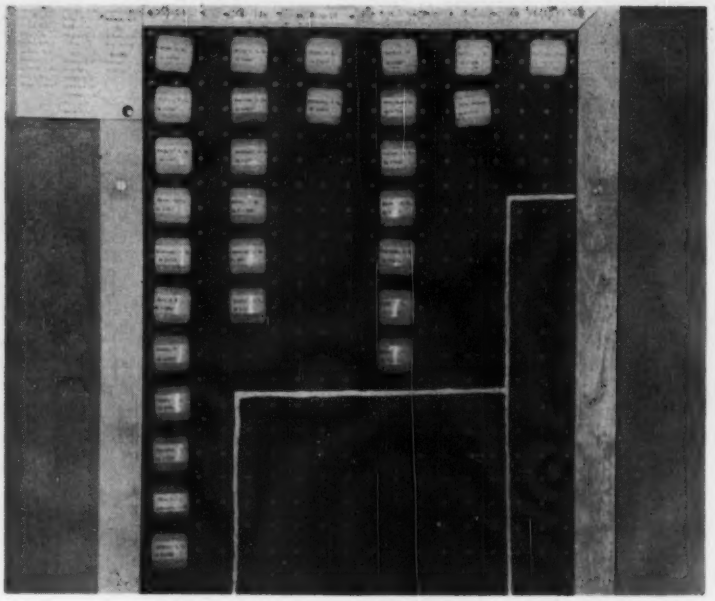
It was on Nov. 22, 1955, that 71.4% of the voters of Stevens County, Wash., voted in favor of selling the properties of the Stevens County Public Utility District to Washington Water Power.

Drawing on the experience in Stevens County in 1955, WWP officials knew they had to take their case directly to the people again in Asotin County.

"We had no 'give aways' we could use to induce our customers to stay with us," Brunzell explained, "only excellent service by interested employees, lowest possible rates consistent with the costs of doing business, and an active interest and participation in community affairs—both time-wise and dollar-wise. When the people clearly understood our position and our intentions they supported us in overwhelming numbers. Now we must make friends of those 23% of the voters who obviously feel the company could do more for its customers and the community."

Peg Board Simplifies Call-Out

R. F. BOGAN, District Foreman, Ohio Power Co, Lima, O.—AEP System

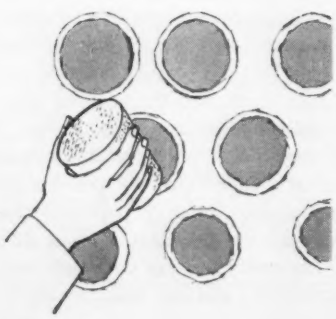


A simple peg-board speeds up the job of forming emergency crews and helps keep overtime equitably balanced among the crew. A further boost in crew morale is achieved since, with the board, each man knows about when his turn is due. Also, the foreman is relieved of keeping track of "who was" and "who wasn't" called.

Each column of the peg board is labelled with separate job classifications. Each man is represented on the board by a peg containing his name and telephone number. The pegs are positioned in rotational order in the column representing the individual job classification. The rotational order, established for each particular job classification, is maintained according to a permanent list, affixed to the left top of the board.

The operation of the board is continuous from one call-out to another. The foreman first determines how many and what classification of men will be needed. He starts at the top of the column (for each job classification), and telephones the first man. If he contacts the first man called, and he is available for work, he pulls the related name peg and places it in the area "called-worked." If he does not contact the first man, or if after contacting the man, the man is not available for work, the peg is pulled and placed under the area marked "called-did not work." This continues until the crew is entirely formed. When the work is over, the board is restored in accordance with the permanent rotational order list, but starting with the men in each job classification who would have been called out next, if the work had continued—these men will be the first called-out in each category for the next job.

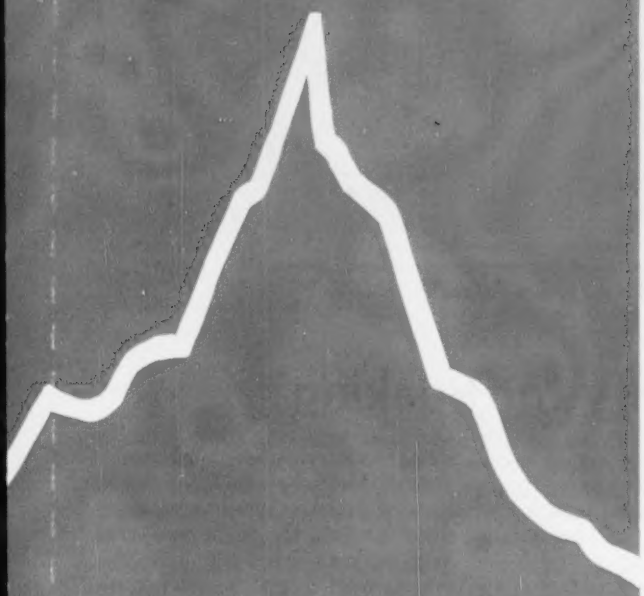
The size of the peg board, wall-mounted near the telephone, can be varied according to the number of men involved. The one used by Ohio Power is about 20 x 24 in. A 1½-in.-sq wood door knob, attached to a short piece of dowel, was used for the pegs. Total cost was about $5.00.



Plug Unused Ducts Economically

GUISEPPE DI PASQUALE, Underground Lines Dept, Detroit Edison Co, Detroit, Michigan

Simple concrete plugs, molded by filling paper cups with concrete, are used in place of plastic plugs for sealing off unused sections of Detroit Edison Co's underground conduit. Cost of paper-cup concrete plug is only eight cents compared to 29¢ each for plastic plugs.



PEAKING POWER

The growing size of generating units on modern power systems and the mounting incremental cost of thermal gains are key factors today behind the increasing investment in boilers and turbine-generators and the steps taken to extend their life in base-load service.

Hand-in-hand with these trends has come a renewed interest in sources of low-cost, low load factor generation that can be dispatched at short notice to handle peak loads, leaving to the new, high-cost, high-efficiency units the base-load duty of high-volume, low-cost production.

Several power sources are particularly attractive today for this service:

***1.** Steam units tailored to offer low-cost, low heat rate operation over a wider range of load and to fit load cycle needs.*

***2.** Low load factor hydro and reversible pump turbine units that use off-peak energy to store water for peak-time recovery.*

***3.** Decentralized low-cost packaged gas turbine and diesel units for peaking and area protection.*

But regardless of which peaking power source they select planners inevitably face the task of developing an optimum combination of peaking and conventional units that best fit expected expansion patterns.

To the clarification of the system problem this entails and a statement of the case for each of these fundamental sources of peaking power, Electrical World offers the following Special Report.

A SPECIAL REPORT ON SOURCES OF PEAKING POWER

Daniel T. Braymer
SENIOR EDITOR

THE SYSTEM PROBLEM

B. L. LLOYD, Manager, Generation Section, K. M. DALE, Engineer, Project Section Electric Utility Engineering Department, Westinghouse Electric Corp, East Pittsburgh, Pa.

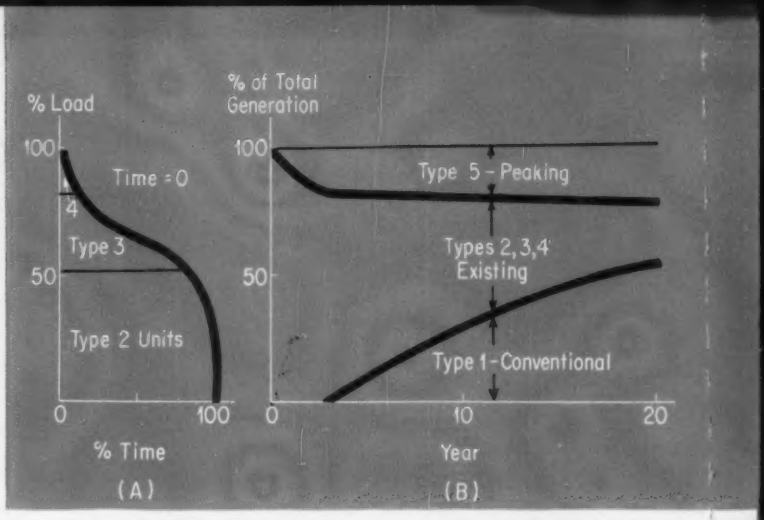


FIG 2—Initial Load Duration curve (a) and optimum expansion pattern (b) for the system defined in Table 1

How Many Kw Can You Justify for Peaking?

To evaluate special purpose peaking units for any system two questions must be answered: Are these units justified at all? If so, what is the best proportion of peaking units and other types of generation to meet system growth? This article tells how these questions can be answered by development and evaluation of long-range generation expansion patterns.

For the realistic model system considered here it will be shown that savings growing out of using a combination of peaking and conventional units increase until a saturation of 16 to 24% of generation exists in peaking units.

Long-range analysis of peaking generation presents two problem areas:

The first is developing accurate absolute values of capital and production costs of the peaking and conventional units. Ultimately, it is the difference between these absolute values that determines whether peaking plants are justified. Because the two types of plants are so dissimilar, this difference can only be obtained if the absolute values are acculately and consistently determined.

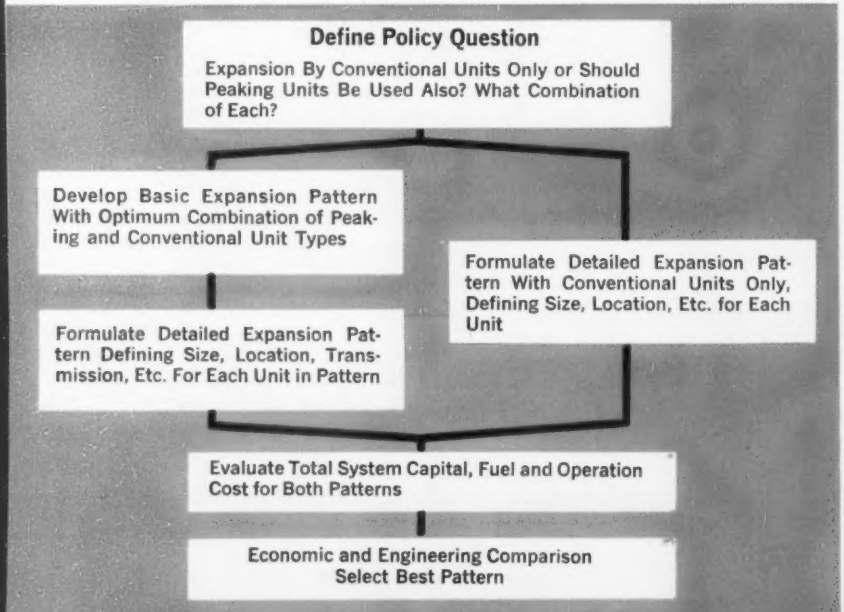
The second is developing the best way of using the various unit types. Fig 1 indicates the procedure for analysis of long-range expansion patterns.

This starts with a precise definition of the various policies which are to be evaluated. Will the system be expanded with base-load units only? Will base-load units be used in combination with various types of peaking units? What are present and possible future interconnection policies to be? What use will be made of nuclear plants?

Next step is to formulate practical generation expansion patterns which accurately reflect each of the alternates being considered. Development of the detailed expansion pattern using only conventional units is fairly straightforward. Such a pattern will list the sequence of units, their size, location, heat rate, capital cost, and other parameters.

Developing expansion patterns which incorporate use of peaking units presents a complication because where future generation expansion is to be accomplished by two entirely different types of generation, the proper combination of

FIG 1—Steps in Development and evaluation of long range generation expansion patterns involving peaking and conventional generation


Define Policy Question
Expansion By Conventional Units Only or Should Peaking Units Be Used Also? What Combination of Each?
Develop Basic Expansion Pattern With Optimum Combination of Peaking and Conventional Unit Types
Formulate Detailed Expansion Pattern With Conventional Units Only, Defining Size, Location, Etc. for Each Unit
Formulate Detailed Expansion Pattern Defining Size, Location, Transmission, Etc. For Each Unit in Pattern
Evaluate Total System Capital, Fuel and Operation Cost for Both Patterns
Economic and Engineering Comparison Select Best Pattern

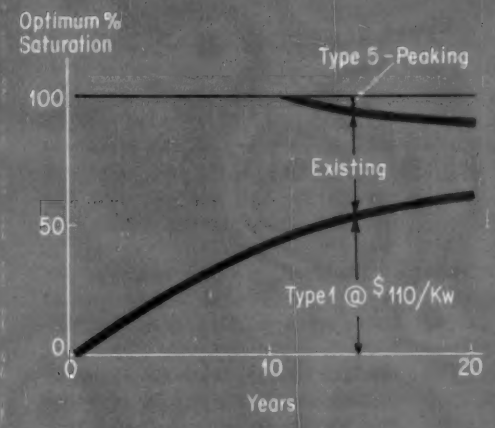


FIG 3—Optimum Pattern for model system with Type 1 units at $110 per kw

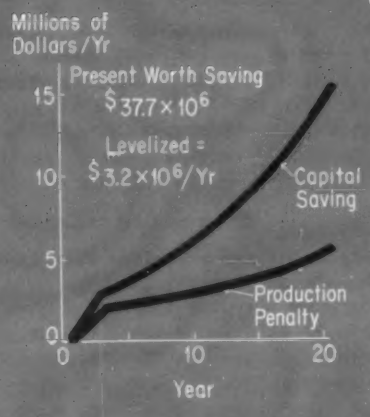


FIG 4—Difference in Costs for pattern of Fig 2 vs conventional units

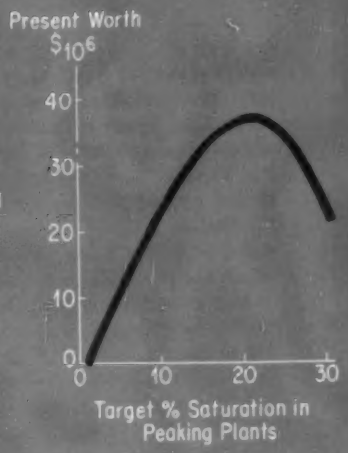


FIG 5—Effect of Deviating from the optimum generation expansion pattern

each type must be used.

The need for preliminary exploratory work on these combination peaking-conventional plans to assure that a reasonably optimum combination is chosen is indicated in the second block of Fig 1. The authors have developed an analytical method which has proven helpful in the development of optimal expansion patterns incorporating different types of units. This method allows for existing units, considers load growth, and will handle systems with any number of existing or new types of generation. Because the mathematical development is cumbersome, it will not be presented.

After reasonably optimized combinations of peaking and conventional units have been established the next step is to convert this to a detailed expansion pattern which defines sequence, size, location, etc. for each unit in the pattern.

The various feasible expansion patterns are then evaluated over perhaps a 20-year growth period on the utility system. This involves determining the total system capital costs, fuel cost, and maintenance charges for each pattern.

Accurate and comprehensive evaluations of alternate expansion patterns is now feasible and economical by use of high-speed digital computers. Several comprehensive Powercasting programs to handle evaluation of expansion patterns have been developed jointly by Westinghouse Electric Corp and a number of utility companies.

Finally, a careful engineering and economic comparison must be made of the various patterns. Engineering and operating comparisons are particularly significant when comparing peaking and base-load units because of the inherent difference in operational characteristics of the two types. In case economic evaluations are quite close, there will often be practical operating considerations which influence the decision.

Model System Example

Let us now consider a specific example to illustrate the form of the results which can be expected from a peaking study based on evaluation of alternate expansion patterns. Characteristics of the model system used in this example are described in Table 1. The system presently has an annual peak load of 1,500 Mw and a system load factor of 65%. Three types of conventional generation are installed on this system:

- High efficiency reheat units installed in the last decade; Type 2.
- Non-reheat units with inlet temperatures of 900-950F; Type 3.
- Old low pressure units which presently operate only during the highest annual peak load period; Type 4.

Capability and average production cost of these three existing types is given in Table 1. Portion of the load duration curve presently occupied by these three types is shown in Fig 2 (a). Annual load growth is 7.2% per year which results in load doubling each ten years. Shape of the load duration curve is not expected to change materially in the foreseeable future.

Policy questions which we wish to study are these: Should future generation expansion be in conventional units only or should they be used in combination with peaking gas turbines? What is the best combination of each? How much is it worth to us to use gas turbines? What will it cost to use more or less than the optimum percentage of peaking units?

The new conventional units being considered for the model system

Table 1
Description of Model System

Peak Load	1500 Mw
Rate of Growth	7.2%
Carrying Charge Rate	14%
Cost of Money	6%
Load Factor (See Fig. 3)	65%

Present Generation

Type	Capability, Mw	Production Cost, Mills/Kwhr
Type 2 (Reheat)	890	2.7
Type 3 (Non-Reheat)	500	3.2
Type 4 (Low Pressure)	278	3.8

New Generation

Type	Capital Cost, $/Kw	Production Cost, Mills/Kwhr
Type 1 (Base-Reheat)	165	2.6
Type 5 (Peaking-Gas Turbine)	95	7.6

are high efficiency reheat units with a capital cost of $165 per kw and a total production cost of 2.6 mills per kwhr; Type 1, Table I. The peaking gas turbine is of the Econo-Pac design with a total installed capital cost of $95 per kw, Type 5. Production cost of the gas turbine is 7.6 mills per kwhr with the fuels which are available in this region.

Many additional factors would need to be defined in an actual study. These would include a pattern of feasible sizes, definition of unit location, size, expected reduction in heat rate of future conventional units, and future pattern of capital and fuel cost differentials between conventional and peaking units. But they will be omitted for purposes of this example.

Develop Best Expansion Pattern

The next step is development of an optimum expansion pattern which incorporates both the Type 1 and Type 5 units. The analytical procedure referred to previously has been used to develop the optimum expansion pattern for this example. The optimum pattern is shown as the curve of Fig 2 (b). For each year of the 20-year period, the amount of each type of generation is shown in percent of the total generation which is in service. Thus, in year 20, the total amount of Type 5 peaking capacity which has been installed amounts to 22% of the total generation in service.

The form of this optimum saturation curve is quite interesting. For the first few years of the study, all of the new generation is installed in peaking plants. Between the second and third year, the installed peaking capacity has built up to a saturation level of 16%. At the end of this initial period, average system heat rate has climbed to the point where the improvements possible by adding Type 1 generation will overcome its higher initial capital cost. Beyond this point, generation expansion is met by an optimized combination of base and peaking units.

One interpretation of Fig 2 is that with Type 5 units available, the system was initially deficient in peaking plants of this type. During the early years this deficiency was corrected, further expansion of generation was by an optimal combination of the two types.

The usual warning should be given against applying this curve to any particular system. The form of the curve depends critically upon production cost of existing units, capital cost differential between new conventional and peaking plants and other factors.

Effect of Cost Is Critical

To illustrate this Fig 3 has been prepared for identically the same system described in Table 1 except that the cost of new conventional units is arbitrarily described as $110 per kw. With this change the optimal pattern results in all new generation being of the conventional type for the first 11 years. At the end of 11 years, further incremental improvements in system heat rate due to adding Type 1 units is not great enough to offset capital cost differential between Type 1 and Type 5 units. Beyond this point, load growth is met by an optimum combination of the two types.

The original policy questions asked for an evaluation of savings comparing the optimal expansion pattern in Fig 2 with a second pattern which used only the Type 1 units for generation. Capital charges and total production costs have been calculated for these two patterns for each year of the 20-year study period. The curves of Fig 4 show the annual capital cost saving and the production cost penalty of the optimal peaking pattern compared to the base pattern with only the conventional units. The difference between these two curves is the net saving attributable to the optimal peaking plan. This difference increases rapidly during the early years as the original deficiency in peaking units is corrected. The rate of increase in savings then levels off somewhat, and during the latter years again increases rapidly. This latter rapid increase is due to the higher load level, the higher saturation of peaking units, and the relatively small improvement in system heat rate effected by further additions in Type 1 units during the last five years or so. Total present worth of future revenue requirements is $37.7 million. This represents an annual savings of $3.2 million per year levelized over the 20 years.

The present worth calculations and determination of levelized annual savings were based on consideration of only the 20-year study period. Another approach to termination of the study period is to assume that this savings shown in year 20 continue to exist for all subsequent years. If this procedure is followed, the present worth of savings is $86 million, and the levelized annual saving is $5.2 million per year.

The final question concerns the penalty that would accrue due to following a peaking plan that differed from the optimum. Obviously one can deviate from the optimum pattern in a great variety of ways. One specific deviation is chosen here for illustration. Fig 2 shows that the optimum saturation in peaking plants quickly reaches a level of 16% and that over the next 18 years, the saturation gradually climbs to 22% with an "average" value in the order of 20%. We have considered saturation trends which are quite similar in shape to that shown in Fig 2, except with average values that are above and below the 20% level. Results of this evaluation are shown in Fig 5. As is to be expected, this figure shows that the savings curve is quite flat around the optimum saturation point. Within the range from 16 to 24% target saturation, the savings are within 5% of the theoretical maximum, which will be within accuracy limits of the original input data. Therefore, we would conclude that a target saturation in the range of 16 to 24% is entirely acceptable for this system. At any given time after the saturation is in this band, the decision between peaking and base load units can be made on the basis of operating advantages or short term considerations which exist at that particular time.

In Summary

So far as we have carried it, the long-range evaluation has turned up no hidden defects. In fact, it looks as though saving will continue to increase until we reach a saturation of 16 to 24% of generation in peaking units. In addition to any immediate short-range benefits, the long-range annual saving adds up to approximately $3 million. It is interesting to note that had the capital costs been those used in Fig 5, the attractive short-range capital benefits of the peaking plant would have proven unsound in the long-range evaluation.

Tailor Steam Units To Handle All Load-Cycle Needs

THE STEAM APPROACH

J. C. BERES, Mechanical Technical Engineer, R. W. POTTS, Professional Engineer, Commonwealth Associates Inc., Jackson, Mich.

Load cycling unit can be made to fulfill system needs for base load, peak load, and spinning reserve

■ Electric utilities generally schedule their big new high-efficiency generating units for base load and use older, smaller and less-efficient units during peak load periods. When the power supply system consists predominantly of such base load generation as this the percentage of older units available for peaking may not be adequate to meet the needs of the system load schedule. As this condition is approached, the desirability of more flexible generation is indicated.

Long-range growth may be accommodated by:

1. Continuing the installation of conventional base-load generation supplemented by units designed specifically for peaking purposes.

2. Adopting the philosophy that major generating units shall be capable of economical operation over the full range of load cycle requirements.

Cost comparisons of these alternatives should be made on an annual basis for the anticipated load conditions.

Several new design possibilities for load-cycling requirements have been considered in recent studies. The results are sufficiently significant to suggest that any study of future generation should consider several departures from conventional base-load unit designs.

One recent study, reported in *Electrical World* (Nov. 7, 1960, p 88), presented a comparison of types of generation with a portion designed specifically for peaking service. For large systems, these comparisons did not indicate appreciable economic incentive in utilizing types of peaking capacity which are presently available, except perhaps with pumped storage hydro generation. It is also recognized that smaller units may on occasion prove to be favorable for

TABLE I—Features of Alternate Load Cycle Unit Designs

Plan	Conditions for Minimum Heat Rate: Steam	% of Rating	Steam Conditions at Rating	Load Cycling Design Features
A	2400 psig 1000/1000 F FFT 530 F	100	2400 psig 1000/1000 F FFT 530 F	Conventional design
B	2400 psig 1000/1000 F FFT 530 F	89	2400 psig 1000/1000 F FFT 410 F	Bypass top 2 feedwater heaters
C	2000 psig 1000/1000 F FFT 500 F	78	2400 psig 950/950 F FFT 420 F	Dual pressure, reduced temperature combined with bypassing top 2 feedwater heaters
D	2400 psig 1000/1000 F FFT 530 F	83	2520 psig 975/975 F FFT 425 F	Dual pressure, reduced temperature combined with bypassing top 2 feedwater heaters
E	2400 psig 1000/1000 F FFT 530 F	83	2400 psig 1000/1000 F FFT 415 F	Spray reheat steam to 25 F above saturation, combined with bypassing top 2 feedwater heaters
F	1800 psig 1050/1050 F FFT 450 F	60	2400 psig 1000/1000 F FFT 480 F	Dual pressure, reduced temperature combined with exhaust annulus area change
G	2400 psig 1000/1000 F FFT 480 F	72	2400 psig 1000/1000 F FFT 530 F	Dual admission—(bypass high pressure turbine) and change in exhaust annulus area

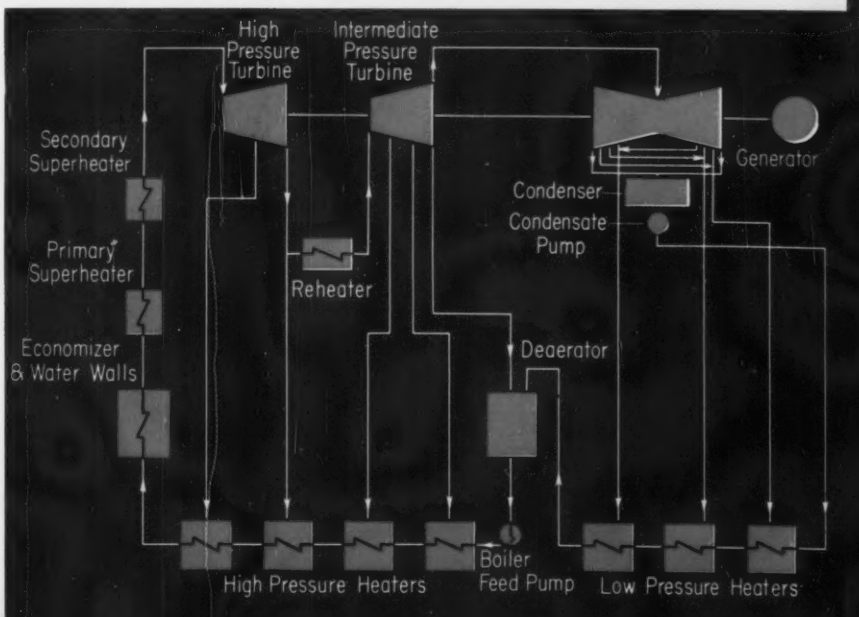


FIG 1—Thermal Cycle Diagram for conventional unit. Alterations offer lower investment and lower annual cost for anticipated conditions

local areas and special situations.

A second report (EW, Nov. 14, 1960, p 60) suggested that an annual evaluation can be of greater significance than obtaining a minimum heat rate for maximum load in the exploration and comparison of large generating units.

Criteria for Load Cycling

The criteria suggested for designing turbine-generator units to supply system load cycling requirements have four basic aspects:

- Units must operate satisfactorily with regard to stability at low as well as high outputs.
- Units should be capable of frequent start-stops without undue maintenance.
- Units should have an extra margin of capability for supplying needed spinning reserve to provide for unexpected load increases or loss of other generating units.
- Resulting generation should have as low an average annual heat rate as justified by the investment to give the lowest total annual cost.

Features of Design

Many features of design are or can be made available that will permit adaptation of large conventional units to supply load-cycling requirements of a particular system. An objective of such changes in unit design is to develop the minimum annual heat rate and cost of capacity which approximates the major economic dispatch of generation for system load cycles. This is in contrast with conventional design seeking development of the lowest heat rate and unit cost near 100% of unit output.

For purposes of the analysis to be presented in this article, six basic plans have been selected for comparison after preliminary consideration of 50 possible deviations from conventional design. Other conditions generally optimized for selection of a conventional unit, such as initial steam pressure and temperature, turbine annulus area, and number of feedwater heaters were considered for each plan.

A 300-Mw coal-fired unit in a two-unit plant was used for the example. Features of design and changes from the conventional diagram of Fig 1 are outlined for the six plans in Table 1. Ratings of all units are the same in these plans and a base rating corresponding to the lowest heat rate for the unit is shown for each as a percentage of the unit rating.

Performance for Load Cycling

Heat rate curves resulting from the six plan designs are contained in Fig 2 and 3 in which Curve A for the conventional design is presented for comparison.

Evaluation of heat rates at various unit outputs is on the basis of weighting factors developed in a previous report (EW, Nov. 14, 1960, p 60) for a typical large utility system. These factors depend on the relative worth of efficiency at each loading and are determined by the number of kilowatthours to be generated at that loading during the year.

Using these factors, the average annual heat rates for the conventional (A) and the six additional plans (B-G) are:

Plan A . . . 9,385 Btu per kwhr
Plan B . . . 9,346
Plan C . . . 9,416
Plan D . . . 9,340
Plan E . . . 9,305
Plan F . . . 9,401
Plan G . . . 9,569

Plant investments, as shown in Table II, are lower in cost per kilowatt for each of the designs for load cycling than for the conventional design. For this comparison of cost estimates, the items of site development, supervision, engineering and overheads are omitted.

Annual costs are included in the tabulation on the basis of both 10% and 15% fixed charges and for both 20¢ and 40¢ per million Btu fuel costs.

Conclusions of the economic analysis are that:

- Initial and annual costs for generation can be reduced with particular design for system load cycling, as compared with conventional units of the same kilowatt rating.
- Variations in fuel costs, while significant in the initial selection of steam conditions and thermal cycle, do not materially affect the comparative results between different design plans.
- Results of this analysis are sufficiently significant to justify the conclusion that any study of future generation for large systems should include consideration of particular designs for the system load cycling requirements.

Physical Plans Outlined

Physical requirements introduced by dispatching units for load cyclic operation can be met when equipment specifications outline these

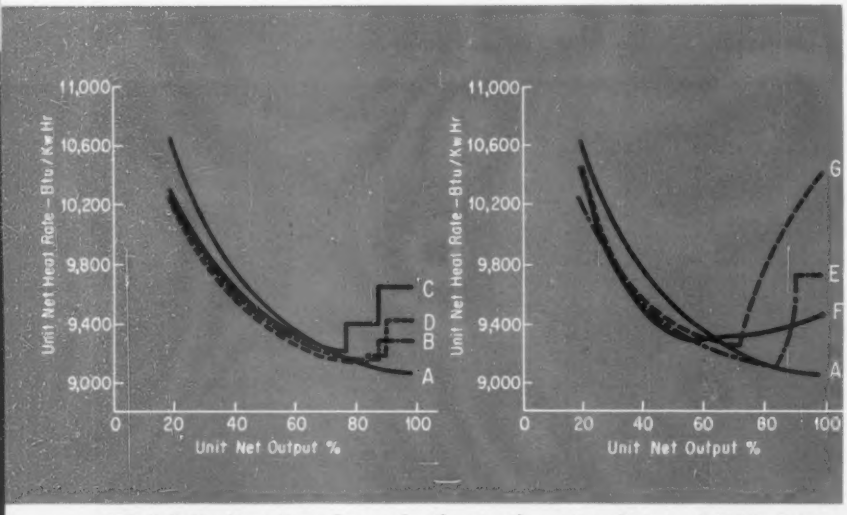


FIG 2 & 3—Heat Rate Curves for the six alternative designs of Table 1 compared with heat rate curve (A) for conventional base-load design

conditions and their requirements.

The basic plans considered in the present analysis include these special features:

Heater Bypassing—At constant turbine throttle flow and fixed initial steam conditions, it is possible to increase the turbine output by reducing the amount of steam extracted for feedwater heating. The greatest increase in capacity would result when the highest pressure heater is valved off from service. Additional capacity gains can be obtained by removing more than one heater from service.

Dual Pressure and Temperature—Increasing the initial pressure and decreasing initial temperature will increase the mass flow of steam through a turbine and thus increase its output with a sacrifice in efficiency. A turbine operating on steam at 1,800 psi and 1,050F with reheat to 1,050F, for example, will have its output increased if pressure is raised to 2,400 psi and steam temperature dropped to 1,000/1,000F, with little change in metallurgical requirements.

Reheat Spray—The addition of reheater spray water to the cold reheat is another method of increasing the mass flow through the lower pressure stages following the reheater and thus increasing the turbine output, with some sacrifice in efficiency.

Dual Steam Admission—For a given set of steam conditions and back pressure, the maximum capacity of a single-entry turbine is determined by the inlet nozzle area. A method of increasing the turbine output would be by admitting additional steam taken from the primary superheater outlet to a lower stage of the turbine where the blade area is greater than at the front. This additional mass of steam will increase the turbine output but with a decrease in turbine efficiency.

Some Special Problems

Special consideration must be given in the selection of steam-generator equipment and in the number, size and type of pulverizers, feeders, burners, etc. These are matters of design that will assure stability at loads at least down to 20% of rating on automatic combustion control while avoiding the necessity for more expensive types of supplementary fuel.

TABLE II—Initial Investment and Annual Cost of Alternate Load Cycle Unit Designs

Plan	Plant Investment Per Kw (1)	Annual Cost Per Kw-Year At 10% Fixed Charges With Fuel Cost (2) Of: 20¢	40¢	At 15% Fixed Charges With Fuel Cost (2) Of: 20¢	40¢
A	$131.00	22.91	32.72	29.46	39.27
B	127.10	22.48	32.25	28.84	38.61
C	127.60	22.60	32.44	28.99	38.83
D	127.50	22.52	32.29	28.89	38.66
E	129.00	22.62	32.34	29.08	38.80
F	123.10	22.13	31.95	28.29	38.11
G	130.20	23.02	33.02	29.52	39.52

Notes:
(1) Omitting estimates for site development, supervision, engineering and overheads.
(2) Coal cost per million Btu. Manning and maintenance costs considered same for all plans.

The steam-generator requires study also because of differences of opinion as to the effect on its life when higher furnace heat release rates and higher absorption rates in steam-producing areas are allowed.

In this category also are the mechanical draft fans and the feedwater and condensate pumps.

Turbine-generators, condensers, feedwater heaters, piping, dust collectors, air ducts and breeching can be sized to provide a nearly optimum heat rate at the base load rating of each plan.

Electric generators for load cycling service can be properly specified and designed so that changes in winding temperatures and the resulting differential expansion does not materially reduce service life of the unit or increase maintenance.

Hydrogen coolers should be adequate to provide relatively low temperatures during peak load by reducing the cold gas temperature, utilizing cooling water control based on hot gas and constant stator temperatures. With such types of control, the differential expansion should be significantly reduced under that expected with constant ambient temperature operation.

Thermal stress and differential expansion are factors that must be given careful considerations for design of units subject to frequent cycling and start-stop operation. Metallurgical and design advances appear to improve the cycling characteristics. Features included in recent designs indicate that the versatility of units can be extended to permit operation under conditions imposed by variable load requirements of systems.

Versatility of Units Improved

Some of these new design advances are:

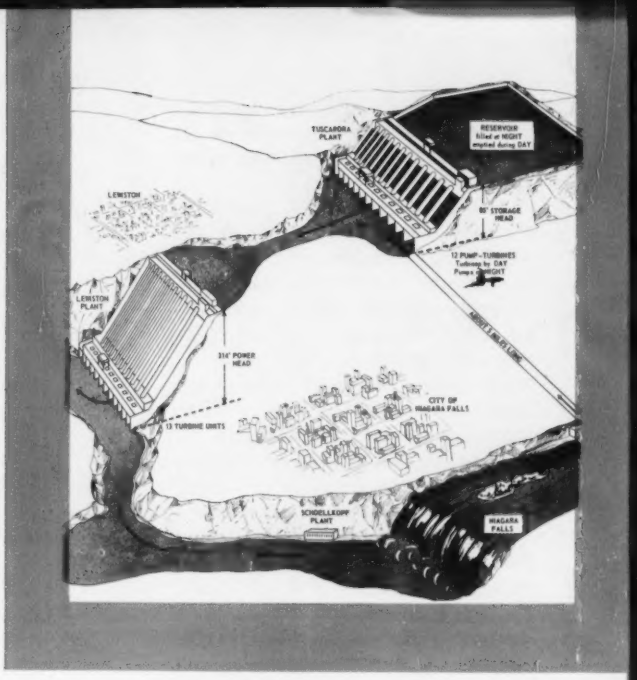
- Improved steam chest, nozzle block and first-stage wheel construction greatly reduces stress concentrations.
- Throttle or stop-valve modifications which permits full arc steam admission to the tubine during the start-up and light-load periods. This will allow prewarming the internal section more uniformly while heat transfer values are low, thus avoiding high temperature gradients between metal parts.
- Improved temperatures detecting and monitoring equipment located at critical points within and around the turbine, allowing closer control for matching of steam and metal temperatures during start up and light load operation.

Manufacturers of major equipment have given their assurance that the design features for low load and cyclic operation can be provided when the specifications outline the operating conditions and requirements. It is expected also that further studies of the economies of design for low load and cycling operation will give added stimulus for research and development to meet the requirements of load cycling design.

CASE FOR HYDRO PEAKING

WILLIAM J. RHEINGANS, Assistant General Manager, Hydraulic Div., Allis-Chalmers Manufacturing Co., York, Pa.

Hydro And Pumped Storage Economic In Low Load Factor Duty



Multiple Plant pumped storage elevates river flowage to reservoir for use later at site and downstream plants. Example is Niagara Reservoir Pump Generating Plant

Although hydro power today supplies only about 20% of the total electrical energy generated in the US, its importance as a source of peaking power is increasing rapidly. Systems that are predominantly hydro, of which there are several in the western states, already depend on hydro power for peaking. Now systems where capacity consists predominantly of thermal power are gradually becoming aware of the advantages of hydro power for peaking either by using existing hydro plants or by installing new hydro units for this purpose.

Today any hydro plant with a load factor below 25% can be considered as primarily a peaking plant. A load factor between 25 and 50% can be considered as a combination of peaking and base load, and above 50% as mainly base load.

For example, Duke Power Co, whose system consists of approximately 2½ million kw of thermal capacity and ½ million kw of hydro, is installing three Kaplan hydro units at Cowans Ford rated 121,000 hp each at 92 ft head. The plan is to operate these units for a short period each day exclusively for peaking. The resulting load factor will be less than 5%. While a 5% load factor is extremely low, it illustrates the trend in present day hydro development.

Alabama Power Co too is designing and building four or five plants of three or four units each which will be used principally for peaking at load factors of 13 to 18%.

Use of hydro units for peaking has these advantages: **(a)** Ease of starting, **(b)** quick starting and loading, **(c)** rapid shutdown, **(d)** low cost of spinning reserve, **(e)** good efficiency and performance over a wide range of loads, **(f)** low maintenance costs, **(g)** minimum outage for repair, **(h)** long life expectancy (40 to 50 years), **(i)** minimum manpower required for operation, **(j)** adaptability to automatic operation and remote control, **(k)** reliability of service.

Some of the characteristics of a system that can use hydro for peak-

TABLE 1—Existing Pump-Storage Plants in North America

Plant	Owner	No. Units	Type of Units	Pumping and Generating Capability Per Unit—Head in Ft	Year Placed in Operation
Rocky River	Connecticut Light & Power Co.	2	Separate (1) Pump & Turbine	500 cfs at 230 33,300 hp at 230	1928
Buchanan Dam	Lower Colorado River Authority	1	Separate Pump & Turbine	804 cfs at 120 17,300 hp at 120	1950
Flat Iron	US Bur. of Reclamation	1	Reversible Pump-Turbine	370 cfs at 240 12,000 hp at 290	1954
Hiwassee	Tennessee Valley Authority	1	Reversible Pump-Turbine	3,900 cfs at 205 83,000 hp at 190	1956
Sir Adam Beck No. 2	Hydroelectric Power Commission of Ontario	6	Reversible Pump-Turbine	4,600 cfs at 75 45,500 hp at 83	1957
Niagara Reservoir Pump-Generating Plant	Power Authority of the State of New York	12	Reversible Pump-Turbine	3,400 cfs at 85 28,000 hp at 75	1961
Taum Sauk	Union Electric Co of Missouri	2	Reversible Pump-Turbine	2,650 cfs at 764 307,000 hp at 790	1962
Smith Mountain	Appalachian Power Co. (AEP System)	2	Reversible Pump-Turbine	4,130 cfs at 187 87,000 hp at 180	1962

(1) One of the original pumps was converted to a reversible pump-turbine unit about 1953

Multiple Purpose Project uses pumped storage jointly with irrigation, pumping between water sheds or river flow storage as at Smith Mountain Project above

Recirculating Project like Taum Sauk Plant of Union Electric Co of Missouri, now building, uses the same water repeatedly for generation with none of it released for other use

ing to good advantage are these:

1. A system capacity above ½ million kilowatt.

2. Predominantly thermal capacity.

3. Daily load fluctuations of 20% or more and/or seasonal load fluctuations.

4. Large capacity thermal units on the system.

The cost of hydro power varies widely, depending upon available head, topography and size of units. But where they can be installed for $150 to $250 per kilowatt, they will probably be an economic source of peaking power for most systems. Sites that can be developed for these costs are still available in many sections of the US. But unfortunately not always near the large load centers.

Thus, in recent years there has been a trend in North America toward the use of "pumped-storage" hydro facilities largely for peaking purposes. In this type of hydro project all or part of the water used for generation is pumped into an upper reservoir where it becomes available for power generation.

The advantages of pumped-storage over conventional hydro for peaking purposes are these:

1. Can be located in favorable terrain where storage reservoirs can be supplied at low land cost and with minimum additional dams and civil structures.

2. Sites can be selected where reservoirs can be provided economically, providing large blocks of peaking power at low costs.

3. Sites can be selected near large load centers to reduce transmission costs.

4. Since storage is usually on a daily or at most a weekly basis, the size of the reservoirs are only a fraction of that required for conventional hydro.

5. Pumped-storage can be installed at a lower cost per kw.

6. There are more economical sites for pumped-storage available than hydro.

7. Pumped-storage projects are not limited in capacity by river flowage and seasonal variations in the flowage.

8. There are more pumped-storage sites available near large centers than hydro since they do not require flowage.

Justification of pumped-storage for peaking in the final analysis must be based on comparative value and costs. Value varies considerably with different systems. The size of the system, type of generating capacity, type of load, daily, weekly and seasonal peaks all play an important part in determining the value of peaking capacity. Pumped-storage can usually be justified where peak energy is expensive and surplus energy at off-peak hours is inexpensive such as where thermal fuel costs are low.

A good rule of thumb for the economic conversion of surplus energy to peak energy with pumped-storage is that 2 kw of peaking energy can be obtained for every 3 kw of surplus energy used to pump the water into a storage reservoir. In some applications it is possible to obtain a ratio of 3 kw generation for every 4 kw used for pumping. This includes all the losses up to the transmission line.

Today a system with predominantly steam generation that has peak loads 50% above the weekly minimum is in an ideal position to use pumped-storage hydro to fill in the valleys on the weekly load curve and take care of the peak. On such a system installation of about 17% of the system capacity in pump-turbines should result in economic use of surplus steam generation during periods of low loads to pump water, that will flow back through these same units during peak demands.

As shown above, there are three types of pumped-storage projects:

1. The multiple-purpose project where pumped-storage is used in conjunction with irrigation, with pumping from one water shed to another, or for other special purposes in addition to regeneration.

2. The multiple plant pumped-storage project where river flowage is pumped into a storage reservoir and later used to produce energy not only at the storage site, but at one or more plants downstream.

3. Recirculating pumped-storage where the same water is used repeatedly for pumping and generating, none of it being released for use elsewhere.

The Flat Iron Plant of the US Bureau of Reclamation is a good example of multiple-purpose pumped-storage. Here a reversible pump-turbine unit and two conventional hydro units are used (See Table I). The hydro units are supplied by a separate reservoir at higher elevation than the one into which the pump-turbine discharges. However, all three units discharge into a common tailrace and lower reservoir. The water which is pumped up into a storage reservoir above the plant by the pump-turbine can later either be released from this reservoir directly for irrigation through high level canals, or can be released through the reversible pump-turbine for power generation and subsequent irrigation through low level canals.

The TVA Hiwassee Plant is a multiple-purpose and river flow storage project. The plant has a reversible pump-turbine unit (Table I) and a conventional hydro unit. During heavy run-off periods, the plant uses river flow to generate power in both units, and discharges water downstream for use at down-river plants on the Tennessee River. During low run-off some of the water discharged through both units during daily or weekly peak periods is held in a lower reservoir and pumped back to the upper storage reservoir by the reversible pump-turbine during off-peak periods.

The Smith Mountain Plant of Appalachian Power Co, (Table I) now under construction, is another example of a multiple-purpose and river flow storage project.

Two examples of multiple plant pumped-storage projects are:

1. The Hydroelectric Power Commission of Ontario's Sir Adam Beck No. 2 Power Plant with six reversible pump-turbines now in operation at Niagara Falls.

2. The Niagara Reservoir Pump Generating Plant of the Power Authority of the State of New York, now under construction. This plant will have 12 reversible pump-turbines (Table I).

Both facilities are unique in that they take surplus water, made available from the Niagara River above the falls at nighttime, and pump it into storage reservoirs with the reversible pump-turbines. During daytime peaking hours this water is released first through the reversible pump-turbines, and then through large conventional hydro units at lower levels for generation of power.

There are no true recirculating pumped-storage projects in operation in the US or Canada at the present time. However, the Taum Sauk Plant being built by Union Electric Co of Missouri is an excellent example of recirculating pumped-storage. It will have two of the world's highest capacity reversible pump-turbines (Table I). In this project the water will be circulated between an upper and lower storage reservoir. Initial filling of the lower reservoir will be made by flowage from two small creeks. This water will then be pumped into the upper reservoir.

Today's renewed interest in pumped-storage plants results primarily from the lack of favorable hydro sites near large load centers and the development of the reversible pump-turbine. With the exception of the Buchanan Dam Plant, all of the pumped-storage projects listed in Table I utilize the reversible pump-turbine as contrasted to separate pumps and turbines. The reversible pump-turbine is a single hydro-electric unit which pumps water while operating in one direction of rotation, and generates power while operating in the opposite direction of rotation.

The cost of a reversible pump-turbine unit, including the generator motor, is only about 50% greater than the cost of a similarly rated conventional hydro unit including the generator. The saving in equipment, powerhouse, water passages and civil works is apparent.

Pumped Storage Explained in Q and A

Doesn't high first cost of pumped-storage rule it out for peaking use?

No! However, the cost does depend on many factors such as: **1.** Availability of existing storage reservoirs, either upper or lower; **2.** Terrain features that determine length of pentstocks and amount of civil works required to construct storage reservoirs; **3.** Land costs; **4.** Head differential between reservoirs. In general, the higher the head available, the lower the cost per kw; **5.** Location of site with respect to load centers; **6.** Total capacity and capacity per unit. Generally the greater the total capacity being provided and the larger the units, the lower the cost per kw. Roughly, a recirculating pumped storage project can be justified economically if its cost can be kept below $150 per kw. There are many pumped-storage sites near load centers in North America that can be developed for $125 to $150 per kw.

How is storage capacity related to peak duration?

Storage capacity and peak durations go hand in hand in that the greater the peak duration the more storage will be needed. In the average system the daily peak load duration is about 30%. Allowing 2% for two change-overs from pumping to generating and back leaves 68% of the time available for pumping. However, with reversible pump-turbines the pumping cycle would not be required all this off-peak time, making it possible to do pumping for shorter periods when low-cost surplus energy is available.

Is pumped-storage more logical for a small rather than a large system?

Pumped storage is more logical for a large system. It is only in exceptional cases or for exceptional load conditions that pumped-storage would be suitable for a small system. Roughly it takes systems with capacities over ½ million kw to justify the use of pumped storage facilities.

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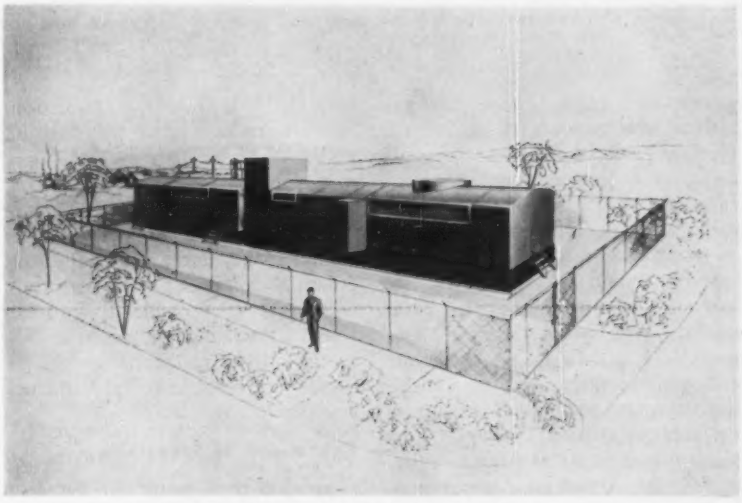
Gas Turbine Peaking Plants Keep System Costs Low

Investment savings added to economies in operating labor cost and curtailment in transmission and fuel cost penalties favor gas turbine for system peaking needs

The decisions on whether and what kinds of peaking generation to install must begin with a careful and realistic analysis of total system costs. This should consider the effect of peaking generation on system operating and maintenance practices, taking into account unit size, location, number of units required, and automatic control features. Finally, we should consider the future needs for peaking, and the impact of today's decisions on the ability to fulfill generation requirements a decade or two hence.

Fig 1A shows qualitatively the investment and fuel cost characteristics of a number of types of generation, while Fig 1B shows how the same types may be applied to a system load duration curve. The relative positions shown will not apply to all systems because of cost differences. The spinning reserve type is shown in a single location based on its maximum output and average fuel cost. Alternatively, it could be shown in two parts: One representing the base rating and fuel cost; the other the incremental peaking capacity and associated fuel cost. Small package diesels, although more suited to local emergency and standby service than to peaking, would appear on Fig 1 in about the same position as gas turbines.



New Packaged Peaking Plant using 11,000-kw gas turbine and that can be shipped on its own base in its own housing at $100 per kw. Plant is automatic

Operating the System

On systems where peaking generation can be economic, the gas turbine will generally fit into the very peak of the system load duration curve.

As systems grow larger, they become more difficult to operate and control. Hence, utility managers question ideas which may further complicate their operating problems. In a large system, sheer numbers of units required to give a reasonable amount of peaking capacity may raise the question of complexity of system operation. In this respect, it is well to note that 10% peaking for a 4,000-Mw system can be provided by twenty-20.5-Mw units. Gas turbine station automation has passed through the development stage and nearly all new installations are unattended and either automatically or remotely controlled. In day-to-day operation as many as 20 of these units (but fewer stations) should prove feasible on a large system.

In operation, peaking generation will normally be the last to be put on the line because of high fuel cost. Also, based on equal incremental loading, such generation should be the last to be loaded. Hence, most of the time, peaking generation will operate at very light or zero loads, and it will constitute a source of spinning reserve for the system.

The gas turbine can start from cold and be at full output in 20 min or less. From normal spinning condition, full load is picked up in 25 sec; in emergencies it may be picked up practically instantaneously.

A new package peaking plant,

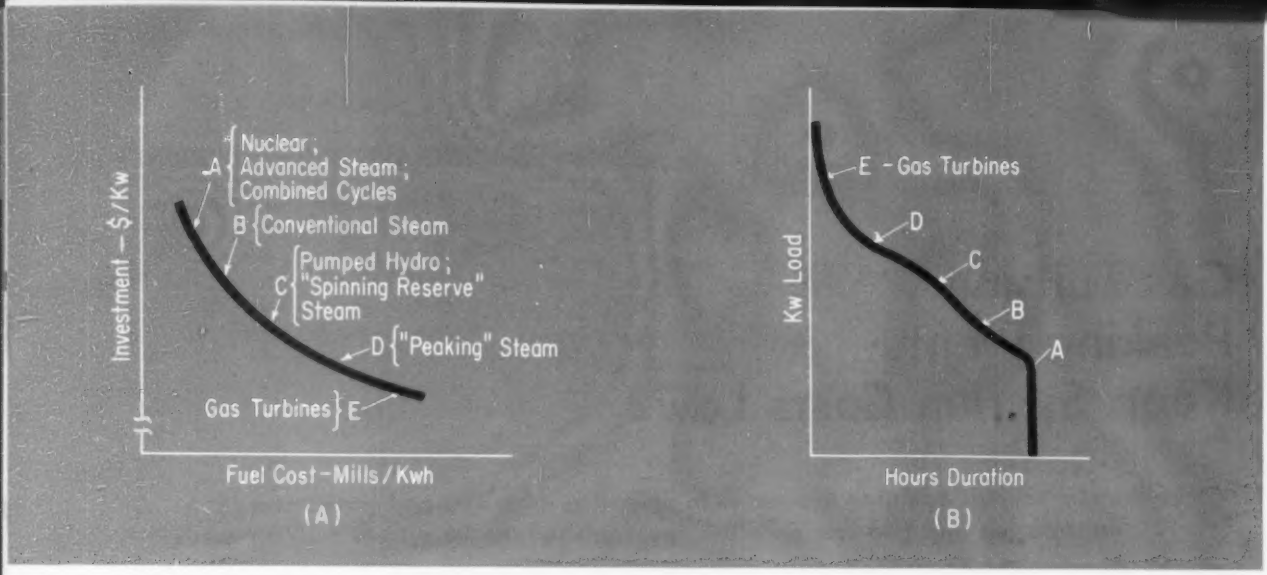


FIG 1—Investment and Fuel Cost characteristics of available forms of generation, both base load and peaking Types of Generation fitted to system load duration curve illustrate how each may be applied in logical sequence

shown, built around the 11-Mw gas turbine, was announced last month. (See page 88.) Except for outdoor main power switchgear and silencers, this plant is shipped to the site on its own base and within its own housing, complete with control room and all auxiliaries. Its fuel may be distillate oil or natural gas or both. Generator voltages from 4.16 to 14.4 kv are available, and an integrated package substation may be included for step-up to subtransmission voltage. The plant priced at $100 per kw is designed for unattended operation, and can get on line in less than 15 min.

Adaptable To Many Locations

Gas turbines can be located very close to the load. With little or no cooling water requirements, and relatively small fuel delivery problems, this can be as close as available real estate permits. In many systems, this can mean tying into the subtransmission system at strategic points, thereby saving investment in bulk power transmission. Also, a reduction in transmission kw loss at time of peak load may save 4 to 5% in required peaking capacity.

As generation moves closer to the load, the question of noise and potential complaint quite naturally arises. It is possible to provide sound attenuating equipment so that reaction from residential neighbors should not be expected at distances beyond 200 ft.

Five Areas of Economics

Specific costs with any form of peaking generation can be evaluated only within the framework of the whole system. Generally, there are four areas of cost saving and one of loss:

1. Investment Saving. A direct saving comes from the difference in per kw cost of peaking and base load plants. Table I gives costs of unattended gas turbine stations, including the generator breaker but not the real estate and site development. In addition to this direct saving, there is often an indirect saving because of deferred investment and closer matching of required capacity which is possible because of the smaller gas turbine unit sizes. This can add 10 or 20% to the direct saving.

In planning to use gas turbines, it is prudent to take maximum investment advantage of their smaller size. In general, this is done by adding gas turbines in a year when no base load steam unit is added, and installing only sufficient capacity to meet the year's growth requirement.

It is not economic to add gas turbine capacity at the same time as a steam unit and reduce the steam unit size correspondingly. Consideration of such a possibility is the source of the erroneous idea that peaking unit investment costs must compete with incremental steam unit costs. In comparing investment costs of alternate expansion patterns, the large steam units used in each pattern must be of comparable rating in order to have comparable system reliability.

2. Operating Labor Saving. The operating labor cost of an automatic or remotely-controlled gas turbine station is nil. While modern large steam units have very low labor cost per kw, there still should be a significant manpower saving when gas turbines are installed in lieu of steam units.

3. Transmission Saving. Depending on system configuration and

TABLE I—Gas Turbine Station Costs

Rating, Mw		Station Cost, $/kw*	
Summer, 80F	Winter, 40F	Summer	Winter
11.0	13.0	100	85
20.5	24.2	100	85

* For automatic stations installed, excluding only cost of land.

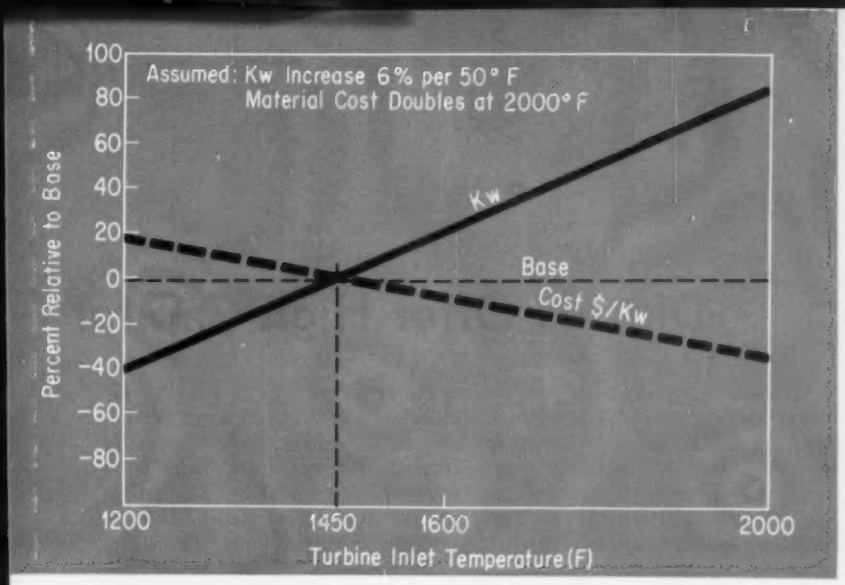


FIG 2—Direction of Development is toward higher gas turbine temperatures. Chart shows increase in unit size and reduction in unit size will take

peaking plant location, there can be a saving of up to $50 per kw due to installing decentralized peaking generation instead of remotely located steam generation.

4. Startup and Standby Savings. The quick startup characteristics of gas turbines means that they are on the line only when required. This is in direct contrast to steam units used in peaking which consume significant amounts of fuel while in periods of standby and startup.

Counterbalancing these four areas of saving is the loss, or cost penalty associated with peaking generation.

5. Fuel Cost Penalty. This penalty requires a careful study of total fuel costs of all units on the system. In order to avoid pessimistic results, the calculation of system fuel consumption should be based on equal incremental loading, as is done in actual operation. This is simple and inexpensive to do with digital computers for which one program is available.

Peaking fuel cost studies have shown that, regardless of the type of peaking:

a. The fuel cost penalty is primarily the result of omitting efficient generation, rather than of adding peaking generation.

b. Because of this, differences in specific fuel consumption of alternate forms of peaking generation are of minor significance.

c. Lower fuel cost penalties will result on systems with more than 50% efficient base load generation.

d. Lower fuel cost penalties result when systems have low annual load factor.

e. The fuel cost penalty is nearly directly proportional to the price of fuel used in efficient steam generation.

TABLE II—Ten-Year Economic Studies

	System A	System B
Peak Load Year—1	1070 Mw	2500 Mw
Annual Growth Rate	7.2%	6%
Reheat Saturation, Year—1	65%	45%
Reheat Saturation, Year—10	81%	66%
Peaking Capacity Added	225 Mw	235 Mw
Average 10-year Peaking Capacity	10%	5%
Steam Plant Fuel Cost	40¢	30¢
Gas Turbine Fuel Cost	70¢	70¢
Fuel Cost Penalty—Year—1	4.0 $/kw	6.0 $/kw
Fuel Cost Penalty—Year—10	1.0 $/kw	3.5 $/kw
Fuel Cost Penalty—Equiv. Annual	1.0 $/kw	2.6 $/kw

Past Studies Show

Approximate results of two studies are given in Table II. In each study, two cases were run:

- **First was a conventional,** or base case in which reheat steam units of 9,500 Btu per kwhr or better heat rate were added;
- **Second was a peaking case** in which gas turbines were added during the ten-year period so as to ultimately eliminate one steam unit relative to the base case. "Reheat saturation" is the percentage of system capacity made up of units with a 9,500 Btu/kwhr heat rate or better. It is interesting to note that the higher saturation of System A, relative to System B, is sufficient to overcome its higher percentage of peaking capacity and higher fuel cost.

The annual "fuel cost penalties" are the difference between base and peaking case total system fuel costs expressed in per kw of peaking capacity installed. These penalties decay from year-one to year-ten as shown. The final equivalent value is obtained by assuming further decay to zero in 20 years and converting all values to a uniform annual series by present worth arithmetic.

Without detailing the method of economic analysis, it is proper to balance this equivalent annual fuel cost penalty against annual investment savings to show the value of peaking generation on these systems. In System A, at 12.5% annual fixed charge rate, the fuel penalty would be balanced by an effective peaking investment saving of $8 per kw. This would be obtained for example, if steam plants cost $120 per kw and gas turbines $112 per kw. If gas turbines cost less than $112 or steam plants more than $120 per kw, there would be a net saving to the system. For System B, the required break-even investment saving is $20.8 per kw.

Consider the Future

Future gas turbines development is toward higher temperatures. Fig 2 shows the increase in unit size and reduction in unit cost that are possible with higher firing temperatures. This, together with other development work in compressor and turbine designs, indicate that the future size trend is up, the cost trend down.

DIESEL VIEW OF PEAKING

B. H. HEFFNER, Chief Electrical Engineer, Electro-Motive Division, General Motors Corp, La Grange, Ill.

Diesels Offer High Capital

■ Based on experience gained with installed and operating units, and on studies by our own and electric utility engineers, it can be concluded that decentralized diesel generator peaking plants today offer the utility industry the highest capital recovery factor of any equipment for available peaking service.

There are three basic reasons:

- Integration of specialized peaking equipment into utility system generating facilities permits full economic use of technological advances in base-load equipment.
- Decentralization of specialized peaking equipment provides additional economic return, as well as an answer to some of the local operational problems created by the steady growth of base-load plants.
- Automatic, portable diesel generating plants currently available come closest to matching the design criteria for decentralized peaking equipment.

Specialized peaking equipment we define as generating equipment designed specifically to perform in the cyclic type of operation characteristic of peaking service, as opposed to a plant designed for base load, or a special adaptation thereof, which is relegated to peaking.

Decentralized peaking equipment we define as being generating equipment located at or adjacent to the load center, as opposed to the central station facility which feeds the load center through transmission and subtransmission lines, or a facility geographically displaced from the central station without specific regard to the load center.

There is general agreement that specialized peaking plants of one type or another will be adopted by utility companies. Therefore this article will deal specifically with the benefits obtained by peaking with decentralized diesel generators.

There are no technical or economic reasons why a peaking facility must be a scaled-down version of central station power, centrally located. But there are many good reasons why peaking equipment should be decentralized and in multiple small-size units. These are:

1. Transmission Investment Deferment—A peaking plant installed near the load will relieve the load on the line during peak. As a result, additional investment in transmission and/or terminal facilities may be deferred several years.

For example, one application concerns a substation carrying a peak load of less than 10 Mw from a single line. About 40 miles of 115-kv line were required to provide a second source at a cost of $2 million. Here a remotely operated decentralized plant of 10 Mw could provide a second source for less than $1 million.

Another case concerns a related situation. Adding 36 Mw of peaking equipment at the load instead of at a central station permitted the elimination of a second 25-mile 69-kv line which, with associated equipment, cost an estimated $800,000. This saving can be expressed as a $125,000 annual saving in fixed charges or the reduction of cost from $100 per kw for diesel peaking equipment at the central station to $79 per kw for the 36 Mw of diesel capacity at the load.

2. Transmission Loss Saving—Most utilities will accept a figure of 5 to 10% transmission loss at the time of peak. Indeed in some situations losses substantially higher are encountered.

For example, one study has shown that each kilowatt of capacity installed at the peaking load location is equivalent to 1.2 kw at the central station. In comparing decentralized vs centralized generation this figure leads to increased central station cost or a lower cost decentralized unit.

In the previous example a 36-Mw

Table I—Ratings and Service Assignment of MU Diesel Units

Company	Location	Type and Size Unit	Date In Service	Service Performed
Maine Public Service Company	Presque Isle, Me.	MU-42 4,200 kw	October, 1959	Peaking, area protection
Iowa Electric Light & Power Company	Ames, Iowa	MU-28DF 2,000 kw	July, 1960	Peaking, area protection
Bangor Hydro Electric Co.	Medway, Me.	MU-80 8,000 kw	June, 1960	Peaking, area protection
Edison Sault Electric Co.	Manistique, Mich.	MU-20 2,000 kw	August, 1960	Peaking, area protection
Interstate Power Co.	Hills, Minn.	MU-20 2,000 kw	Sept., 1960	Peaking, area protection
Public Service Co. of Oklahoma	Grandfield, Okla.	MU-20 2,000 kw	August, 1960	Peaking, area protection
Sierra Pacific Power Co.	Reno & Carson City, Nev.	3-MU 60 18,000 kw	October, 1960	Peaking
Newport Electric Corp.	Newport, R. I.	MU-40 4,000 kw	November, 1960	Peaking, area protection
Long Island Lighting Co.	Northport, L. I., N. Y.	MU-40 4,000 kw	November, 1960	Peaking, test, area protection
Philadelphia Electric Co.	Philadelphia, Pa.	MU-60 6,000 kw	June, 1960	Peaking, test
Pennsylvania Electric Co.	Benton AFB, Pa.	MU-40 4,000 kw	December, 1960	Peaking, area protection

Recovery

plant at the point of load is the equivalent of 40 Mw at the central station. The $100/per kw cost for peaking power now reduces to $70 when compared with central station power.

3. Spinning Reserve Savings— Properly designed, decentralized peaking equipment can serve as a portion of spinning reserve. Spinning reserve represents a sizable operating cost item.

The more comprehensive studies of larger blocks of peaking diesel plants contemplate qualifying this capacity, as "spinning" reserve.

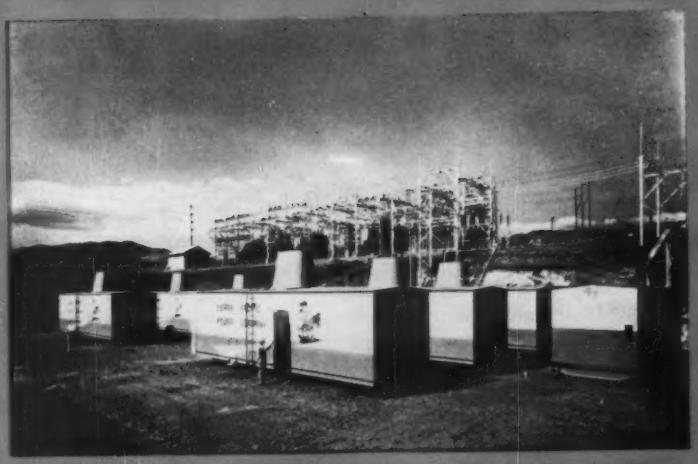
For example, in one case where 80 Mw of spinning reserve is required, it was planned that 60 Mw of peaking diesel plants would be installed. In view of the fact diesel capacity could be fully available within seconds, the system would be operated with a 20-Mw requirement for steam spinning reserve.

This type of application is feasible with the diesel generator plants because each new 10-Mw plant on the system can supply capacity at the rate of 5 Mw per minute from standstill condition.

4. Positive, Economic, Area Protection — While a decentralized diesel peaking plant is basically designed to feed into a loaded line— so that it must synchronize with the system and follow both voltage and frequency, it can also be designed for use as area protection. With suitable modification a unit can pick up a dead line and supply the load as the sole source of power until such time as transmission service is restored.

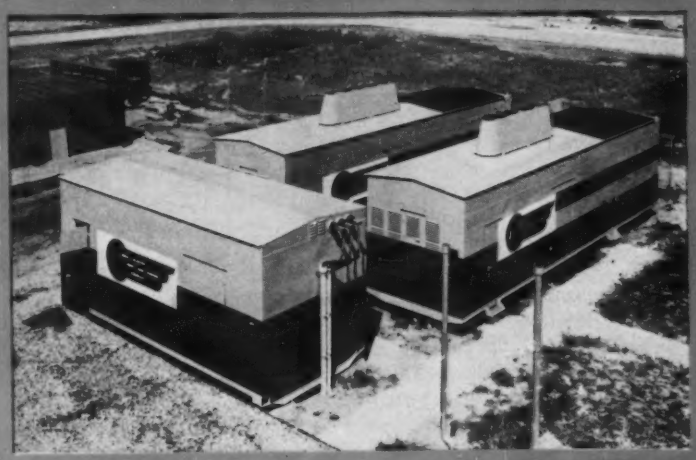
5. Reduced Maintenance Reserve Requirements — Where reserve is provided with multiple unit equipment that is not associated with base load plants, the availability of reserve to the system is increased.

For example a 50-Mw block of reserve which may be five separate plants can be maintained 2 Mw at a time, leaving 96% of the re-



Sierra Pacific Power Co installation of two 6,000-kw plants at Reno, Nevada. Another 6,000-kw plant is at Carson City

Bangor Hydro Electric Co 8,000-kw plant at Medway, Maine, provides both peaking service and area protection



Iowa Electric Light & Power Co unit in an industrial area of Ames, Iowa, is a dual fuel facility for peaking and area protection

serve continuously available regardless of maintenance requirements. This capacity is available any time independent of season and available for extended operation when reserve requirements demand it. Completely independent diesel reserve capacity can protect any base load equipment running and is not limited as it would be if it were integrated with a central station. The system reliability is increased.

6. Increased System Stability—By its very nature, a decentralized system of peaking plants distributed over a utility system and located adjacent to various load centers should contribute to the overall stability of the system. Such an arrangement will provide improved reactive load capabilities.

Many of the advantages of the diesel generator peaking plant are inherent in the prime mover. The diesel engine used in the plant is in mass production, is readily portable and has established a reliability record based on 25 years of heavy duty operation. Equally important, it lends itself well to the building block principle. This means it is possible to install diesel peaking plants of nearly any size in increments of 2 Mw from 2 to 30 Mw or more. Moreover, all plants can operate at the same low heat rate.

Here is how the diesel generator plant meets design criteria for utility service as decentralized peaking equipment:

A. Service as Specialized Peaking Equipment

1. Low investment cost—a plant can be installed, ready to run on a 13-kv bus for $100 per kw or less.

2. Specifically designed for cyclical operation.

3. Preparation time for peaking service very low.

4. Heat rate; 10,150 Btu or less.

5. Long maintenance cycles despite cyclical service.

B. Decentralized Installation

1. Designed for and equipped with automatic controls for completely unattended operation.

2. Sized to fit capabilities and needs of decentralized locations—it can be installed at the step-down substation from sub-transmission to distribution.

3. Quickly, easily and inexpensively installed.

4. Fits into the surrounding community as a good neighbor from the standpoint of appearance, sound characteristics, and cleanliness.

C. Transmission Investment Deferment

1. Short lead time from placement of order to going on line, thereby making short term deferment feasible.

2. Easily portable so that if it is necessary or desirable to relocate, virtually no installed investment is left behind.

D. Spinning Reserve Service

1. Can be started remotely and reliably and brought to load in 60 to 90 sec.

2. Proven reliability of prime mover, generators, controls and circuitry in actual line performance.

E. Area Protection Service

1. Automatically picks up a dead load and carries the load until the system returns to normal and will go automatically from peaking to dead load pickup in any sequence.

2. Individual power units automatically share load between generators.

F. Reduce Required Reserve

1. Closer forward planning with small increments of short lead time equipment reduces need for "margin for error" reserve.

2. Maintenance reserve requirement reduced because spinning reserve represented by this equipment is not actually spinning.

3. Maintenance reserve reduced because in large power units, the whole block of power is down while in this "building block" power, only an incremental amount, i.e., 2 Mw is down at any one time.

Reliability of fast-start of diesel peaking plants was proven during a one-year test conducted by Philadelphia Electric Co. Of 822 individual generator starts during the test, the diesels operated perfectly 815 times, a reliability percentage of 99.15%. In addition, the fast-start time, from zero to full load, ranged from 46 sec to a maximum of 82 sec during the test.

Decentralized diesel peaking plants have demonstrated a heat rate of 10,150 Btu per kwhr or less.

Dead load pick up capability was demonstrated in the case of the Public Service Co of Oklahoma, twice within the first two weeks of operation. The OG&E unit at Grandfield, Oklahoma, picked up a dead load to protect the city, an oil refinery and a TV station.

The Bangor Hydro Electric Co unit has automatic dead load pick up and load sharing. It is controlled by signal from the manned hydro station, and any one of the generators, or the whole plant at once, can be started by remote control. In case of line outage it starts automatically on signal from the hydro plant, picks up the load and rides up and down with it, sharing load between generators until service is restored.

The Iowa Electric Light & Power Co plant is a dual-fuel installation, operating on either natural gas or diesel fuel, and is remotely started and stopped for peaking service. It also provides protection for a government research laboratory which is served by two separate lines. In case of a line outage, automatic throwover switches shift load to the other line and simultaneously start the plant which comes to full speed with no load. If the second line goes out, the plant takes over the full load until service is restored, then automatically synchronized and shuts down.

Several utilities have acquired diesel peaking and reserve plants pointing up advanced planning for incremental increases in peaking requirements. Interstate Power Co, Edison Sault Electric Co, Newport Electric Corp, Long Island Lighting Co and Pennsylvania Electric Co all have acquired units looking toward expansion. The latter three utilities bought 4-Mw units with provisions for expansion to twice that size.

Reprints of the *Electrical World* Special Report on Peaking Power are available at 25¢ a single copy. Address requests to: Editorial Department, *Electrical World*, 330 West 42 Street, New York 36, N.Y.

23% Lighter
25% Smaller

NEW GENERAL ELECTRIC 500-KVA DISTRIBUTION TRANSFORMERS OFFER GREATER CAPACITY IN LESS SPACE

Now you can mount three 500-kva distribution transformers in the same space formerly required for three 333-kva units. This 500/560-kva unit is only 61 inches tall, and its total weight has been reduced to 3000 pounds. Similar weight and size reductions apply to other 500-kva ratings as well as 250- and 333-kva sizes.

Operating characteristics have been improved too. Total losses have been lowered as much as 13 percent. And, you get the extra 12 percent kva capacity of General Electric's Permalex* transformers, increasing the installed kva capacity of a 500-kva unit to 560 kva, or the capacity of a bank of three 500-kva units to 1680 kva.

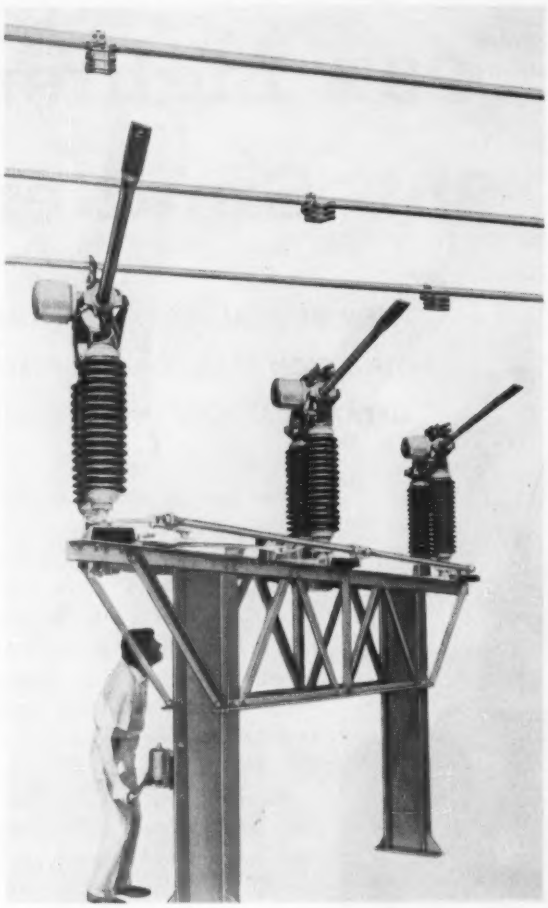
Find out about the significant savings that are yours when you use General Electric large distribution transformers. For details, see your General Electric Sales Engineer or write to Section 483-05, General Electric Co., Schenectady 5, New York.

** Reg. Trademark of General Electric Co.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

New Switch Cuts Initial Cost and Saves Space



A 69-kv two-insulator-stack vertical-break switch (left) has been designed and developed by Delta-Star Electric Division, of H. K. Porter Co, Inc, as part of a substation order for Teheran. Designed specifically to meet the Iranian system's requirements, the new switch is used where ground space is at a premium and circuitry permits the jaw contact to be mounted above the switch. First of its kind to be built by Delta-Star, it saves space, initial cost and structural steel, says the company.

Designated MKU-40, it is a modification of the company's standard MK-40 vertical-break switch. In the MKU-40, one insulator stack rotates to operate the blade without links, levers, or braids. The switch has no third stack for mounting of the jaw contact.

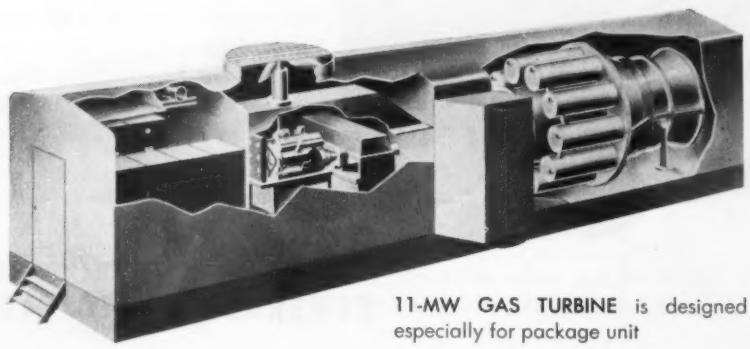
Initial cost is cut by the elimination of three insulator stacks, one on each unit of the three-pole switch, also elimination of three bus support assemblies and columns and several feet of main bus, tap bus and connectors. Also, there is less steel required to support the switch, Delta-Star says. The switch takes less space in substations, saves space and weight in packing and shipping.

The jaw contact is mounted on the 3-in. copper tubing bus, directly above the rotating stack. The hinge contact is mounted, by means of an auxiliary arm in the switch frame, just over the mechanism on the rotating stack. Thus, the switch is closed when the blade is in vertical position.

The jaw contact can also be mounted on an underhung insulator stack if no bus is present. Use of a jaw contact on a fourth stack would allow the unit to be used as a selector switch or double-throw switch, points out Delta-Star.

GE Markets 11-Mw Gas Turbine Package Unit

General Electric Co recently announced the availability of a gas turbine package power plant with an 11-Mw gas turbine and all associated accessories and controls in an 80-ft-long unit. It sells at $100 per kw and is operable ten days after delivery.



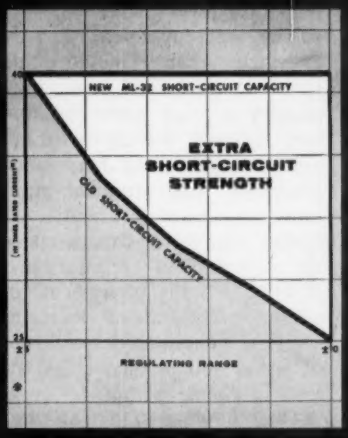
11-MW GAS TURBINE is designed especially for package unit

Simultaneously, South Carolina Electric & Gas Co said it had purchased four of the package units to be used in new installations in Beaufort and Charleston, S. C. The economy represented by use of natural gas as a fuel for low-cost electric power was an important consideration in the move, according to the utility.

Alternate fuel is distillate oil. The simple-cycle, single-shaft gas turbine is designed specifically to meet space requirements of the package concept. It is rated 11 Mw

(*Continued on page* 90)

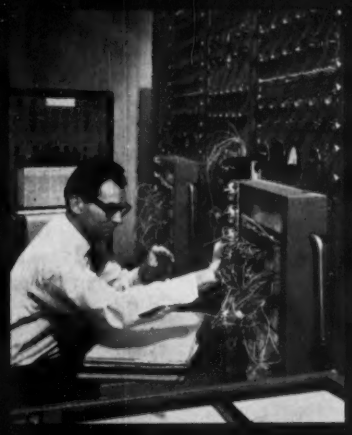
SEVEN STEPS AHEAD IN VOLTAGE REGULATION



1 Increased short-circuit strength for longer regulator life

2 New Melalast cover finish increases protection against outages

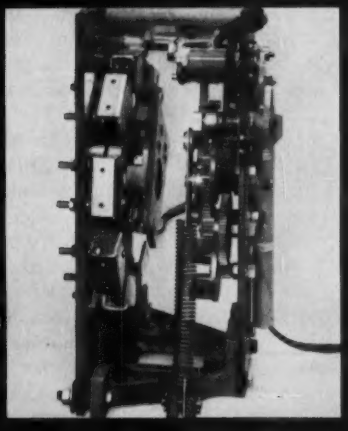
3 New positive neutral indication protects linemen and equipment



4 Computer studies prove reduced bandwidths increase system earnings

5 Cyanoethylated coil insulation boosts reliability, lengthens life

6 New counter proves no increased operation at reduced bandwidth



7 Controlled switching speed maximizes contact life

1960 innovations emphasize General Electric leadership in voltage regulation

Watch for more to come in '61. Meanwhile, ask your G-E sales engineer for complete information about the full line of General Electric voltage regulators. Or, write General Electric Company, Section 456-6, Schenectady 5, N. Y. *Voltage Regulator Product Section, Pittsfield, Mass.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

REBUILDING?

General Electric offers complete line of "Factory Engineered" replacement parts

Your obsolete or burned-out distribution transformers can be made as good as new with General Electric's complete line of "factory engineered" replacement parts. In addition to renewed dependability, G-E replacement parts permit inexpensive modernization of old units—such as higher voltages and kva ratings, and the addition of self-protecting devices.

General Electric renewal parts are manufactured to new equipment standards of performance, giving you factory quality for all devices and components. You'll be able to take advantage of such modern features as Permalex* core and coils, new bushings, clamps, gaskets and protective devices.

Uprating and modernization of your existing units can be accomplished in one of General Electric's 55 Apparatus Service Shops or in your own repair shop. And you'll get "off-the-shelf," 24-hour delivery of all G-E renewal parts. You can realize real dollar savings by utilizing the many up-to-date operating advantages of G-E renewal parts. For more information, see your General Electric Sales Engineer or the Representative from your G-E Service Shop. General Electric Company, Schenectady 5, New York. 485-05

* Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

for peaking service, using either oil or gas fuel. Continuous rating is 10,250 kw with gas, 9,500 kw with oil.

The self-contained, factory-assembled power plants are ideally suited for peak load, emergency, or standby service, according to GE. Key features, the company added, are: low initial cost, maximum site flexibility, fast installation, and minimum operating expense.

The plant is capable of operating on a system in conjunction with other generating equipment, or at a completely isolated location. It can start without any external source of power and be on the line at full load in about 15 min.

Overall dimensions of the installed package power plant are about 80 ft long and 35 ft wide. Net station rating for peak-load service is 10,750 kw, using gas or distillate oil at 80F and 1,000 ft.

Two basic units, plus accessory equipment, make up the integrated power plant. The first unit, or power package, contains—within a common housing—the gas turbine, complete controls required for local or remote operation, mechanical and electrical auxiliaries, batteries and battery charger, closed-loop cooling system, and starting equipment.

The second unit, or generating package, contains—within a similar common housing—the generator, reduction gear, exciter, neutral current transformer, field breaker, discharge resistor, metering shunt, and generator air filter system. Accessory equipment includes inlet and exhaust ducting and the outdoor metal-clad switchgear compartment.

The $100 per kw for use as a peak-load station includes labor and direction of installation. The only items not included in the package-plant price are the land, foundation, required fuel storage and handling equipment, distribution facilities, and local transportation from the nearest rail siding to the plant site.

The entire package-plant installation will fit on a quarter-acre house lot. Conservative estimates indicate that with nominal advance site preparation, a package plant can be started within ten days after arrival at the site.

Characteristics tailored to utility cost and flexibility requirements in-

(*Continued on page* 92)

WESTINGHOUSE improves new transformers 5 ways with aid of REVERE ROLLED COPPER in coil winding

New design extends range of lightweight pole-type transformers to 500 Kva

In seeking to solve the problem of cross-sectional requirements in the winding of conductors in low-voltage coils of large Distribution Transformers, Westinghouse design engineers noted that their primary concern was: How to reduce the number of individual conductors in the low-voltage windings.

The final design is one which uses a sheet of copper across the width of the low-voltage coil so that one turn becomes one layer. The thickness of the sheet is varied to give the required sectional areas (see photo lower left).

Westinghouse engineers, in collaboration with Revere and other suppliers, wrestled with the problem of securing a satisfactory sheet material for this purpose for over a year. The layer insulation was designed to be sufficient for turn-to-turn insulation; this eliminated, from an electrical standpoint, the need for insulated sheet copper. However, this method presented still another problem. For, to accomplish this, the copper sheet had to be sufficiently burr free to permit the use of a single sheet of thin layer insulation. The answer to this problem was the development of a smooth Revere Rolled Copper sheet, which contributed to giving the new Westinghouse sheet-wound copper design transformer the following outstanding advantages:

1. A compact coil of great inherent mechanical strength against short circuit forces.

2. Reduction in losses and impedance by reducing the high-low space to a minimum.

3. Weight reduction directly through reduced mean turn and indirectly by eliminating coil bracing.

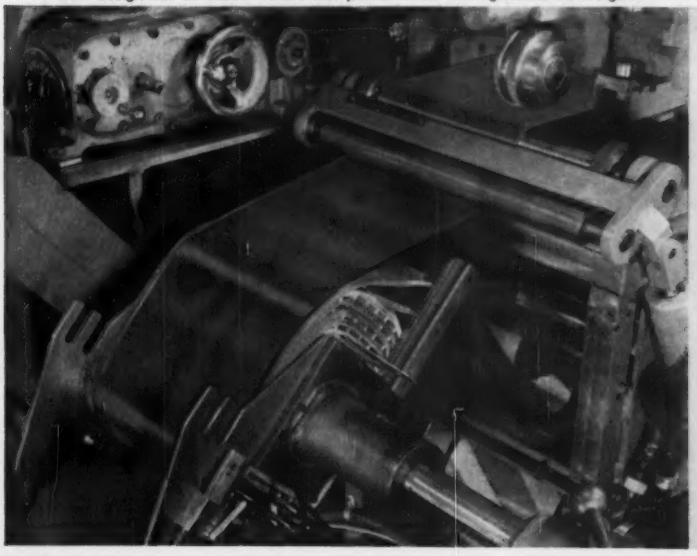
4. More effective cooling obtained by removing coil blocks and braces.

5. Total lower weight of unit which permitted extension of pole mountings to ratings which were previously available only in the substation type.

Find out today how Revere Rolled Copper can be used to advantage in your coil winding application.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.
Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bedford and Plymouth, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

PACE-SETTING sheet-wound coil design uses a sheet of copper across the width of the coil so that one turn is one layer of the Low-voltage coil. The new design has enhanced transformer performance and lightened the weight.



ONE OF THE WESTINGHOUSE transformers—a 500 Kva, 7200 Volt rating—incorporating the new design. Previously available only in the substation type.

*Trademark

"Superforms* help me insure Uninterrupted Service" ...TRANSMISSION ENGINEER

"Superforms help me accomplish my Number One Job Function:

"*Keeping millions of dollars worth of equipment in constant service for many thousands of customers.*"

Transmission Engineers not only must know the requirements for their lines . . . they must also see that they are met. And, they have found that Fanner Superformed products are always reliable. A-1598A

FANNER Superformed with a "PROTECTIVE TWIST"

ARMOR RODS . . . Protect long-span T&D lines at supports

LINEGUARDS . . . Protect short-span T&D lines at supports

PATCH RODS . . . Repair damaged conductors

TAP ARMOR . . . Protects conductor at tapping points

FANNGRIPS . . . For dead-ending strands and conductors

FANNSPLICES . . . Join two ends of conductor wire

PLASTIC PRODUCTS . . . For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.

clude: (1) Factory assembly and testing to reduce installation time and expense; (2) No external source of cooling water necessary, permitting maximum site flexibility; (3) Pre-engineered and preassembled packages; (4) Compact station arrangement to minimize space requirements; (5) Short delivery; (6) Unit design, combined with minimum foundation and site investment, to make plant relocation economically feasible; and (7) Optional dual-fuel system to permit lowest possible operating costs.

MANUFACTURERS BRIEFS

• **McGraw-Edison Co** reports net sales and miscellaneous income for the nine months ending Sept. 30 were $233,250,000, as compared to $210,752,000 for the similar period in 1959. Net income for this 1960 period was $10,600,000, compared to $11,298,000 for the same period in 1959.

• Record sales and earnings were reported by **Thomas & Betts Co** at the end of its nine-month period for the year. Sales were $17,261,000, compared with $16,144,000 in the comparable period a year ago. Net income amounted to $2,042,000, compared with $1,987,600 in 1959. In an interim report to stockholders, N. J. MacDonald, president, cited the company's stepped up program of new product promotion and its accelerated research and development programs as accountable for the highest sales and earnings in T&B's history.

• **Rea Magnet Wire Co,** a division of Aluminum Company of America has started construction on a 26,000-sq-ft research laboratory. The building is expected to be ready for occupancy in September of 1961, the company says.

• **S&C Electric Co** is sending four road-show models of its new Circuit-Switcher family of load interrupting devices into the field for demonstrations to interested utilities and consultants in this country.

Precision Transformer Corp opened a distribution transformer plant on Nov. 15 in Centex Industrial Park, Elk Grove Village, suburb of Chicago. It more than doubles the company's work space and increases production capacity over 200%.

High Sunspot Activity Mars Transmission Operation

Considerable voltage variation, increased excitation requirements and reactive flow, and induced currents in telemeter circuits were among phenomena noted Nov. 13 on high-voltage transmission systems of Northeastern utility companies. These accompanied giant sunspot activity and occurred over a period lasting from 8 to 10 hr.

Random occurrences of uncontrolled voltage variation of considerable magnitude were recorded on the Consolidated Edison Co 138-kv transmission lines. These, the company believes, were caused by higher than normal magnitude of current in the earth's surface accompanying the increased solar activity. Differences of earth potential at widely separated points, where wye-connected transformers in the transmission system have their neutrals grounded, are believed to have caused direct currents to flow so as to saturate or magnetize the transformer cores. Excitation requirements were thereby increased and system voltage dropped in an erratic pattern.

Appreciable increase of var flow was noted on the Public Service Electric & Gas Co transmission lines, and Niagara Mohawk Power Corp experienced voltage variations and difficulties with tie-line control equipment besides the induced currents in the telemetering equipment.

An aurora borealis of extraordinary brilliance was perceptible at 5:25 am in the upper part of New York State. Hydro-Electric of Ontario was among companies experiencing transmission voltage changes. The last comparable solar activity was on Easter Sunday, 1938.

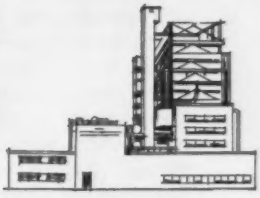
Landis Named EJC President

James N. Landis, vice president of the Bechtel Corp, was elected president of the Engineers Joint Council, succeeding Augustus B. Kinzel of Union Carbide Corp. Landis, a past president of the American Society of Mechanical Engineers, was with Consolidated Edison Co from 1936 to 1948 as head of contract control and with Brooklyn Edison for 13 years prior to that.

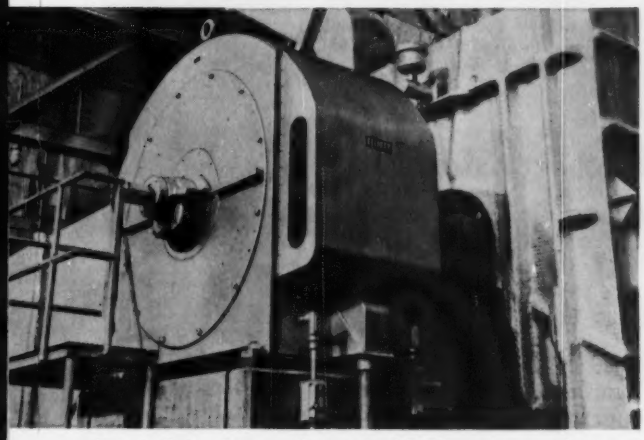
Here's another Elliott Record!

8 YEARS OF TROUBLE-FREE SERVICE...OUTDOORS

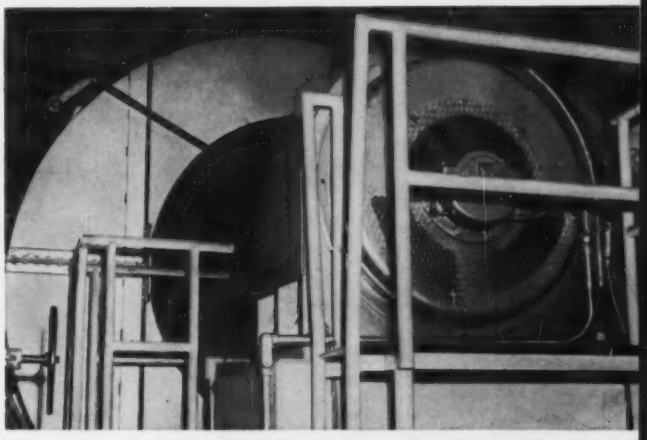
in 30° below to 100° above weather



It happened at Montana Power's outdoor station in Billings. Elliott weather-protected and dripproof motors in this "farthest north" outdoor station have not even been opened up and have required no maintenance whatsoever since installation in late 1951. This record was achieved even though these motors were on peaking service, with enhanced possibility of corrosion damage to bearings, or from moisture collecting on the windings.

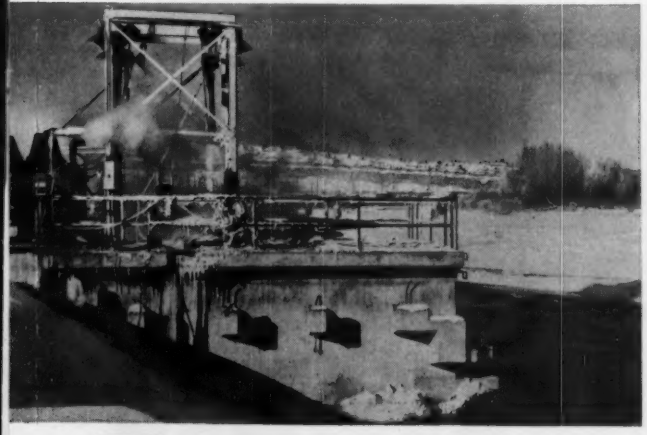


Exposed to rigorous hot-and-cold Montana weather and large amounts of snow, this Elliott 1000-hp, weather-protected type 2 motor is perpetually ready for action to power an induced-draft.

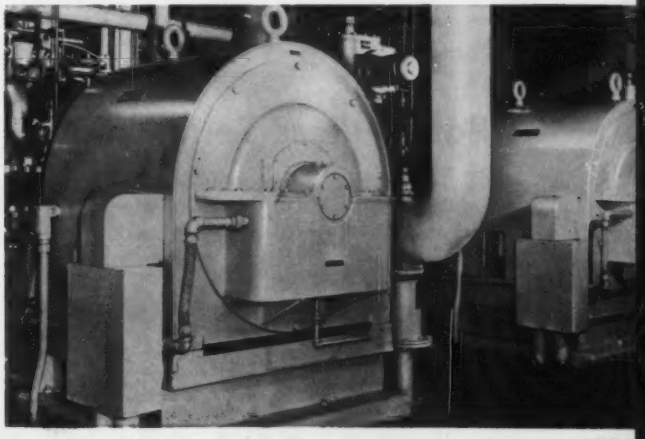


One of two Elliott 700-hp, 900-rpm, dripproof motors inside a semi-outdoor structure provide dependable power for forced-draft fans in peaking service.

On the banks of the Yellowstone River, the 500-hp, 12-pole Elliott vertical hollow-shaft, weather-protected type 2 motor shown below drives a circulating-water pump.



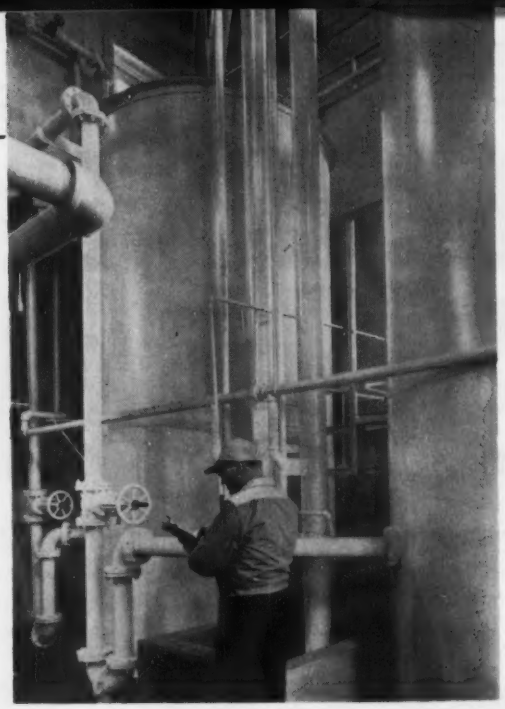
These two 1250-hp, 2-pole squirrel-cage induction motors have chalked up an enviable performance record of trouble-free service driving boiler-feed pumps.



RO-5

ELLIOTT Company Ridgway, Penna.

New Equipment

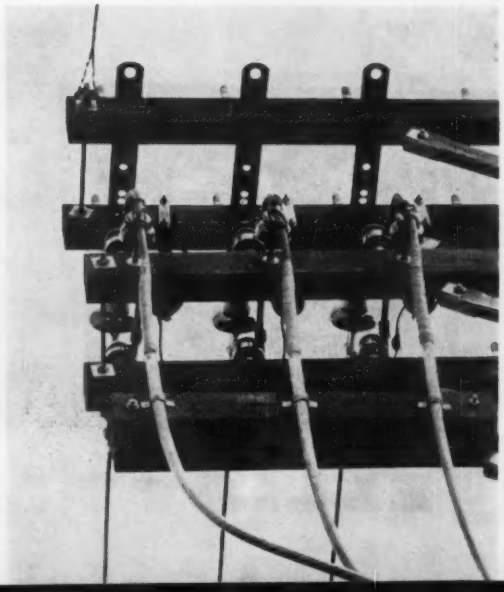


Gravity Water Filter . . .

. . . operates fully automatically and with zero power. The automatic valveless gravity filter, usable wherever gravity feed is feasible, operates on a loss-of-head. The filter cannot over or underwash, and backwash or rinse water cannot be run accidentally in service. The unit consists of a vertical steel tank divided into backwash storage chamber at the top, filter bed compartment, and collector chamber under a false bottom.
Permutit Co, 53 W 43rd St, New York 36, N. Y.

Distribution Transformer . . .

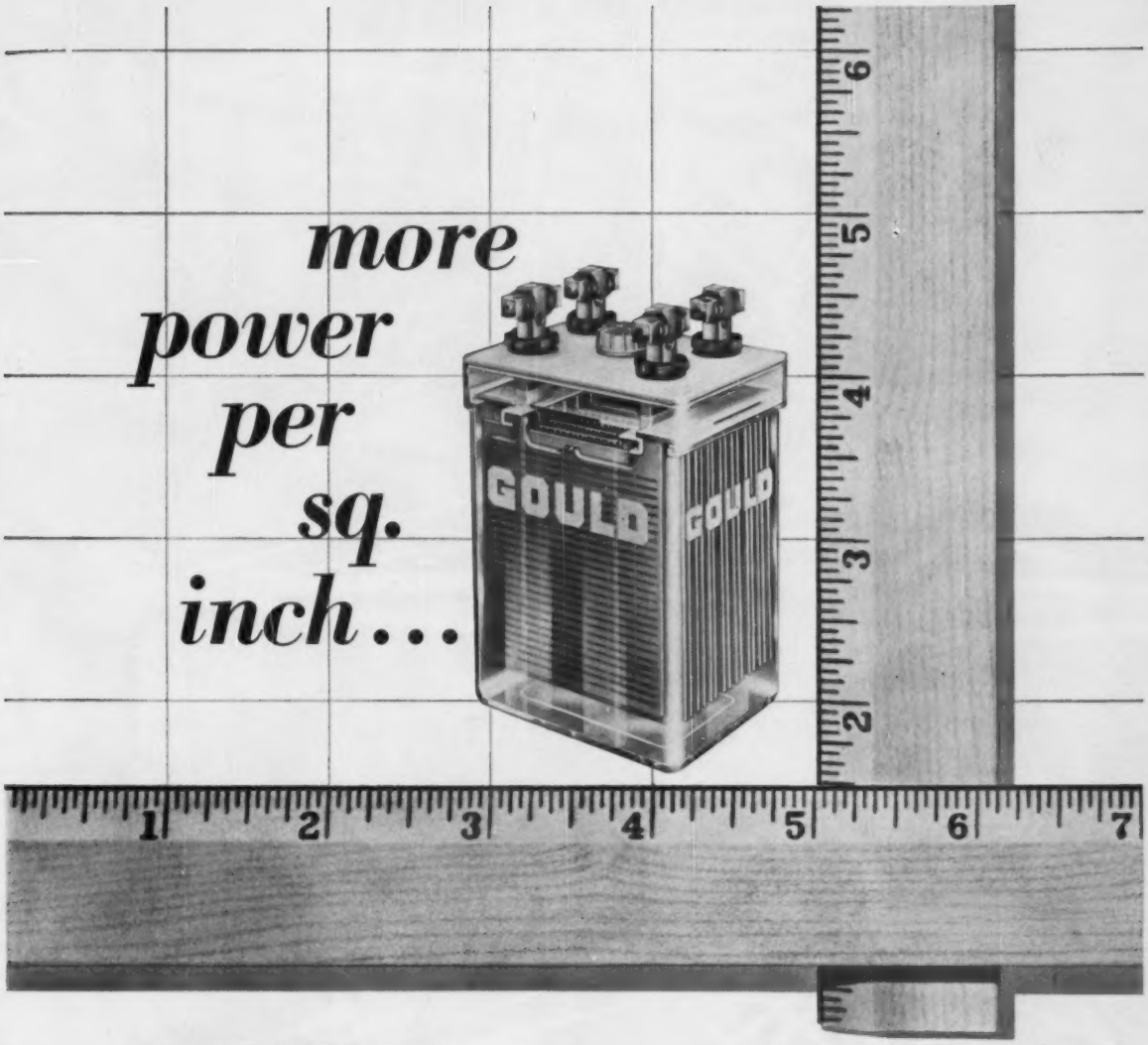
. . . has all primary-voltage parts isolated within a shielded and grounded compartment to insure safety to personnel. The weather-tight compartment prevents service interruption from flooding and physical transfer of leads. Dead-front design of the Saf-TT-Front Terra-Tran guards the public against contact with live parts. It has a full-capacity load-break switch suitable for loop or radial systems. The switch compartment can be drained and removed for installation on another unit.
RT&E Corp, Waukesha, Wis.



Potheadless Termination . . .

. . . for 5-kv paper-lead cable is for indoor and outdoor service. Cable accessory kit No. 705 makes an hermetic termination of epoxy resin and orlon tape. It is oil-tight, moisture-tight and weatherproof. The stress cone may be omitted.
Epoxylite Corp, 1428 N Tyler, South El Monte, Calif.

(*More New Equipment on page* 98)



GOULD *stationary batteries*

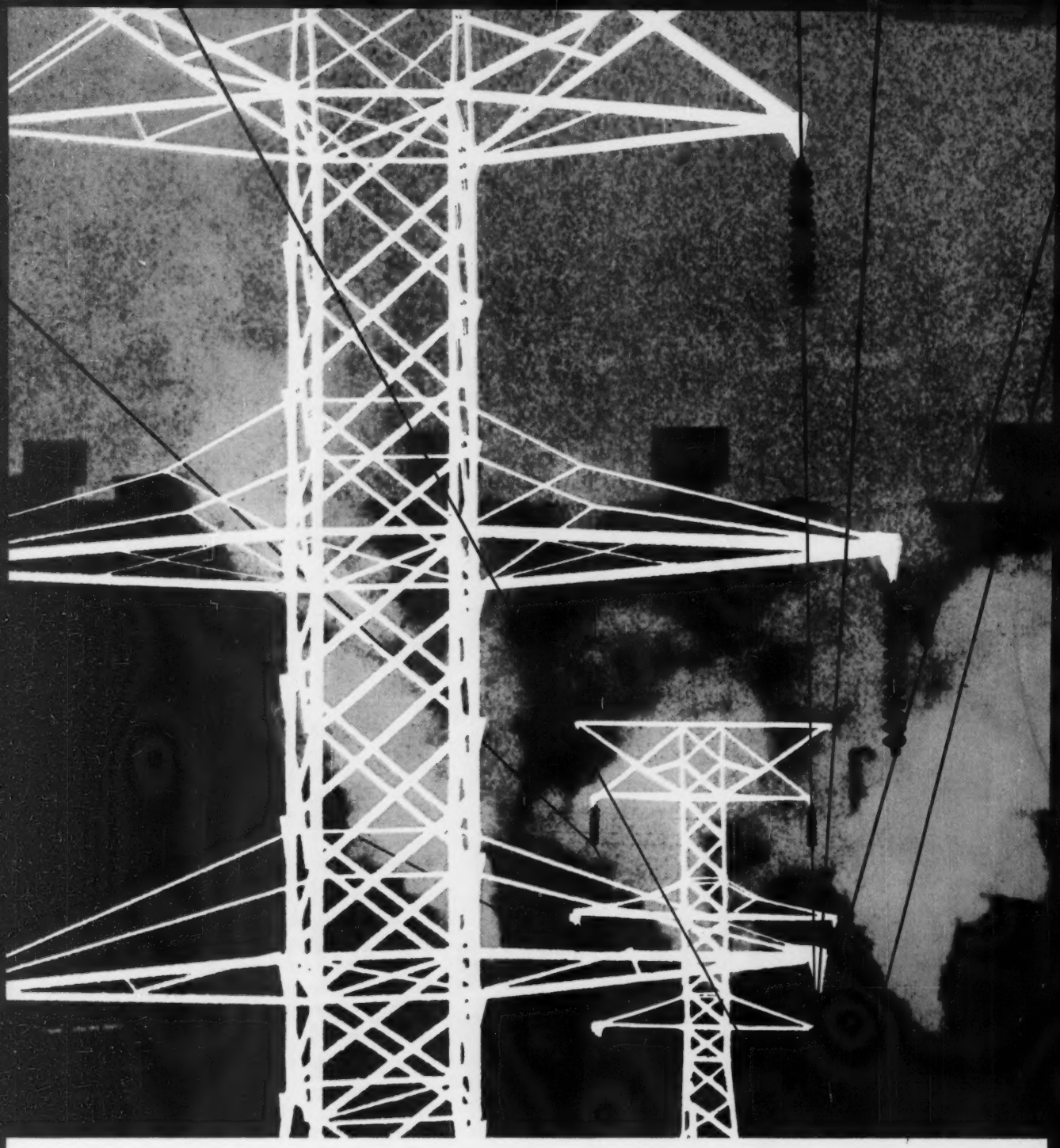
In the new, compact Plastrite Jar, Gould Stationary Batteries save 30 to 40% floor space. This means much greater power in a lot less space—you can actually increase your battery room capacity without increasing the room size!

All new design assures top performance. New Silicone O-Ring post seal expands under compression, prevents escape of electrolyte. New stronger posts assure full current-carrying capacity with maximum voltage at all times. Improved element suspension eliminates possible cover breakage due to weight of battery element.

For big power when you need it—quick, reliable current for longer than a moment—new Gould Stationary Batteries in Plastrite Jars offer long, trouble-free service either full float or cycle operation.

Gould Stationary Batteries in Plastrite Jars are available in Planté, Calcium, or Kathanode. Write for details today, or call your local Gould office listed under "Batteries—Industrial" in the Yellow Pages. Gould-National Batteries, Inc., Trenton 7, N. J. In Canada, write to Gould-National Batteries of Canada, Ltd., 1819 Yonge Street, Toronto, Ont.

More Power to you from **GOULD**



Alcoa Structural Division designs and fabricates aluminum towers and substation structures that defy corrosion caused by salt spray, chemical fumes and, indeed, industrial atmospheres of all types. They never

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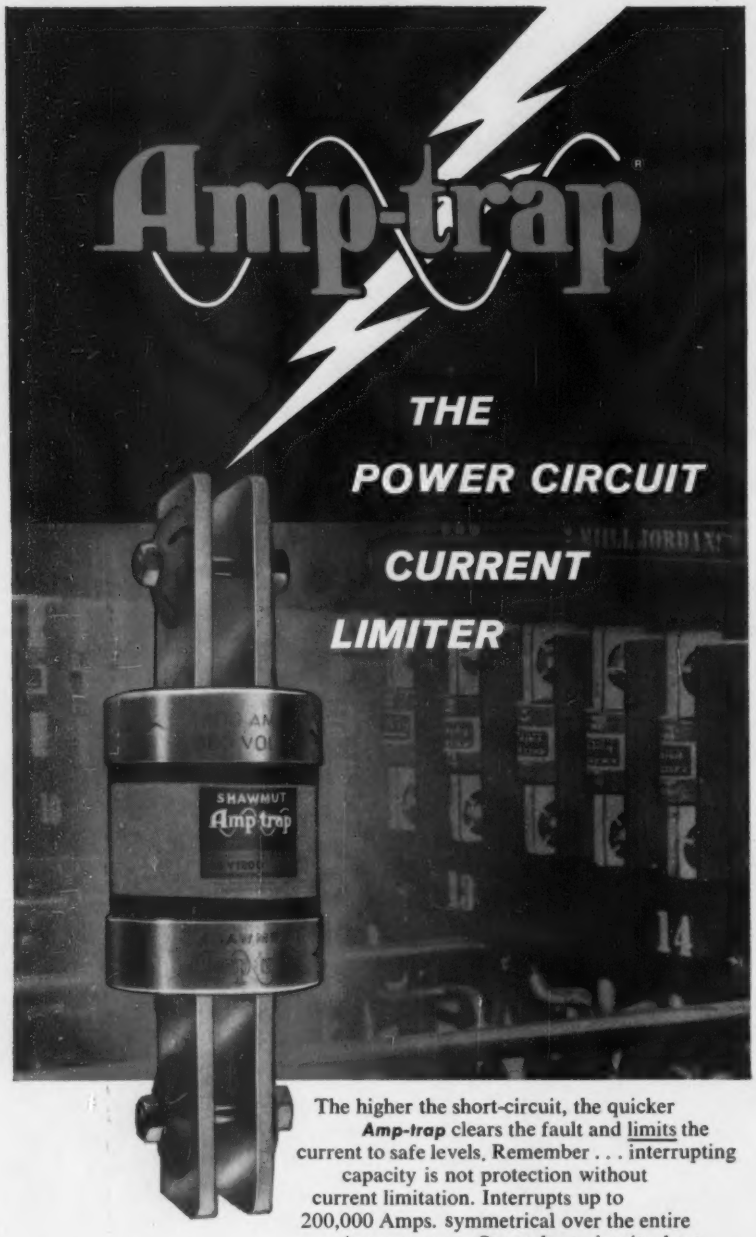

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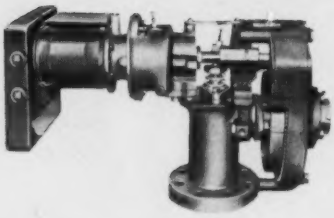
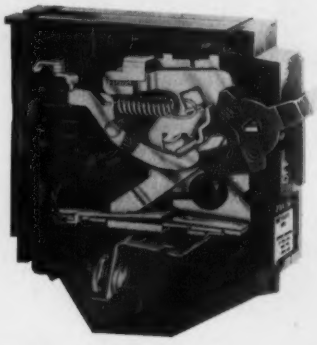


Soot-Blower Head . . .

. . . for indoor or outdoor installation uses as the blowing medium air, saturated or superheated steam, water, slurring or any combination of these. The rotary unit is for service through 1,500 psi. It can be installed on the side wall or roof, horizontally or at any angle above the horizontal.

Copes-Vulcan Div, Blaw-Knox Co, Erie 4, Pa.



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. . . with duplex circuit breakers holds twice as many breakers in the same space as a single-breaker load center holds. Back-to-back assembly of two circuit breaker mechanisms in a single circuit-breaker case of standard size makes the space saving. They come in 15 and 20-amp combinations. Boxes are available in 2 to 42-circuit sizes.

Bryant Electric Co, Bridgeport 2, Conn.

Reference Source . . .

. . . for meter calibration provides ac and dc. It can also be used as a voltage or power source and as a voltmeter. The portable model No. 5890 provides voltages in four ranges to 100 v at supply-line fre-

(*Continued on page* 100)

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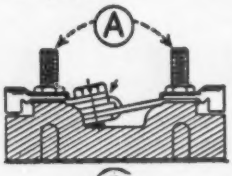
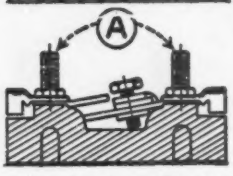
States exclusive sliding link feature permits checking circuit at any time without disturbing permanent wiring. It's as easy as A, B, C.



A. Just attach instrument to terminal posts.



B. Slide link out of contact — take reading.

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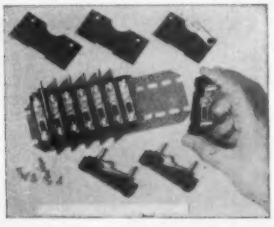
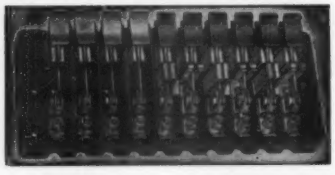
All testing done without touching permanent wiring. Built in any number of poles desired, front or back connected, with or without coding strip, with or without cover.



Above shows how individual units are mounted on metal strips cut from 65 poles lengths. Thus "NT" Blocks may be obtained complete, or as parts to be assembled to fit any given installation.



- Safety Grip Handle assures safer, easier operation.
- Maximum pressure at jaw contacts.
- Over 2,200 combinations of pole arrangements.

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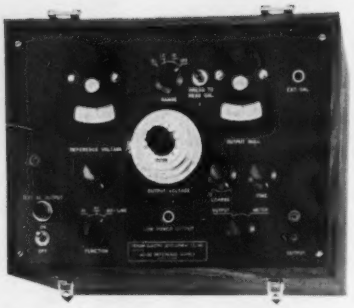
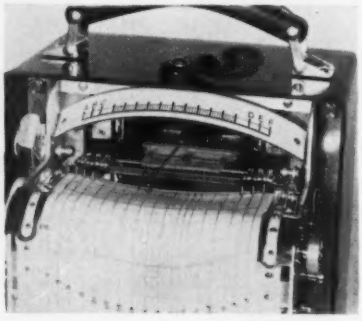


quency. Accuracy is within ¼%. **Commercial Products Div, Tensor Electric Development Co, Inc, 1873 Eastern Parkway, Brooklyn 33, N. Y.**



Analog-Events Recorder . . .

. . . plots on one chart such values as current and potential plus the times of related events. The pen in the center portion records analog measurements. Six chronograph pens show on-off times or timing pulses along the two margins. Through tranducers, the unit can record pressure, speed and other non-electrical values.
Esterline-Angus Instrument Co, Box 596, Indianapolis 6, Ind.

Meter Socket . . .

. . . and load-center combination with aluminum enclosure has space for six 240-v, 2-pole circuits. Available ratings are 100, 150 and 200 amp. The single-phase, 3-wire unit has an insulated groundable neutral as standard. It is listed as class NI non-interchangeable service entrance equipment.
General Electric Co, Plainsville, Conn.

More New Products

Vibration amplitudes of motors and other machines are measured by the Davey **Vibrometer** model 1. Its ground glass scale is mounted at 30 deg for convenient reading.—Vibroscope Co, Glenford, N. Y.

The E32NA dual-switch **indicating temperature control,** which controls up to four circuits, has a standard rating of 15 amp, 115/230 v ac. Other ratings are available.—United Electric-Controls Co, 79 School St, Watertown 72, Mass.

Protection against oil, dirt and weather is afforded by **pushbutton enclosures** with 1 to 25 stations. They are furnished in slim, standard, pendent and extra deep models. —McKinstry Metal Works, Inc, 285 McKinstry Ave, Chicopee, Mass.

For electric generating plants of 2,500 w, Idle-MATIC **speed control** regulates engine speed to save on fuel and reduce maintenance and noise.—Onan Div, Studebaker-Packard Corp, Minneapolis 14, Minn.

Mounted in a case which clips into the pocket, **electrical contact burnisher** No. 160 is for servicing industrial equipment. No. 180 is for electronics.—Adre, 1005 S 26th St, Milwaukee, Wis.

Type 301P-S15 and 301-P-S30 stab-in **fuse bases** have no fuse shells. The non-tamperable units meet the standards on non-interchangeability. — Federal Pacific Electric Co, 50 Paris St, Newark 1, N. J.

Flow monitor measures mass flow of air or gas. A wide range of ranges is available. The unit provides an electric signal for remote indication.—Hastings-Raydist, Inc, Hampton, Va.

Span suppression of 1:10 to measure accurately small pressure increments is provided by the f/b-LINE **pressure transmitter,** which is available in five pressure ranges to 7,500 psig. Accuracy is within ½% of the metered range.—Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

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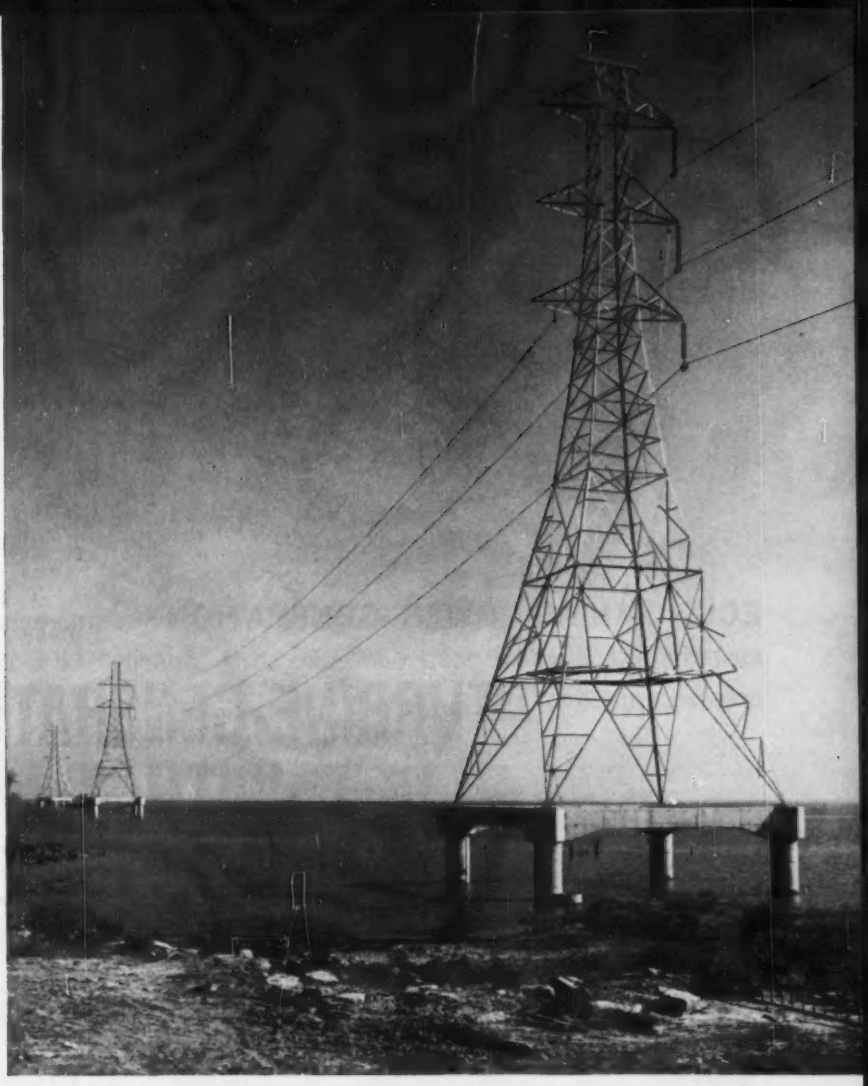

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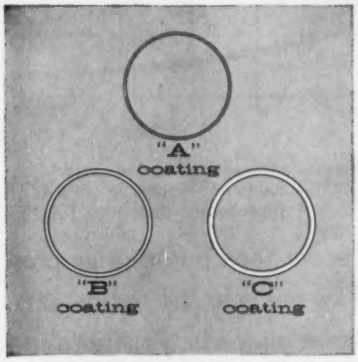
...steel backbone for high-tension conductors



Bethanized ACSR core wire is available in 3 coating weights.

Bethlehem ACSR core wire gives these high-tension wires the strength of steel they need for long spans. And that strength also helps them to hold up in stiff winds and ice storms.

Stranded about standard aluminum electrical conductors, Bethlehem ACSR core wire has a time-tested zinc coating that assures trouble-free stranding. Our unique electrolytic process, called bethanizing, bonds virtually pure zinc on the steel wire . . . smoothly and uniformly for long-lasting corrosion resistance.

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Just a phone call will put you in touch with a Bethlehem sales office. Or write to us at Bethlehem, Pa., for further information on ACSR core wire or other grades of steel wire.

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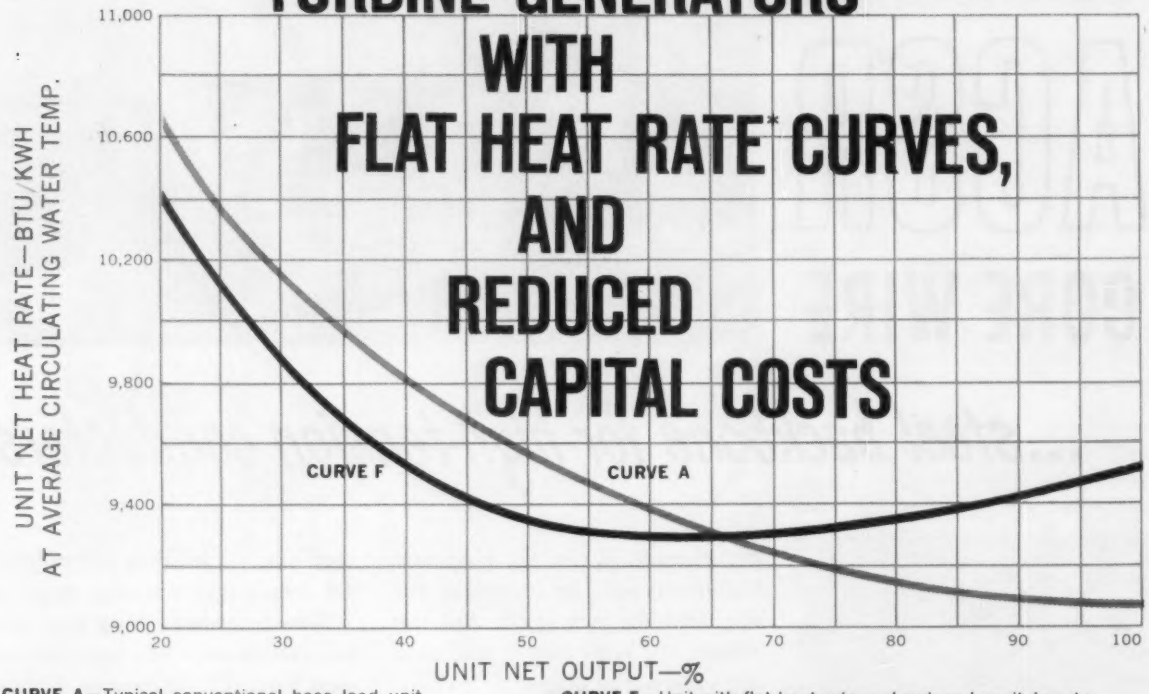
TURBINE-GENERATORS WITH FLAT HEAT RATE* CURVES, AND REDUCED CAPITAL COSTS



CURVE A=Typical conventional base load unit. 2400 psig, 1000 F initial temp.—reheat to 1000 F.

CURVE F= Unit with flat heat rate and reduced capital costs. At high loads; 2400 psig, 1000 F initial temp.—reheat to 1000 F. At lower loads; 1800 psig, 1050 F initial temp.—reheat to 1000 F.

Matching of steam conditions, exhaust annulus area and type of boiler feed pump drive provides a unit with significant reduction in annual costs per installed kw per year, no restrictions on operative time at 100% unit output, and full feedwater heating at all loads. **For more information, contact your Westinghouse representative or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.** You can be sure . . . if it's Westinghouse.

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*±1% from 40-100% of unit output

J-50621

Electrical World

DECEMBER 5, 1960

Management Newsletter

Frank Talk Boosts Performance

The ability to talk purposefully is one of the prime tests of the successful manager. The manager who gets the most from his employees knows how to talk man-to-man. He makes it a point to see them often in a friendly, informal atmosphere. When a bottleneck slows up the company's operation, he goes straight to the source of the problem. He goes to the people involved.

People are complex. When you accepted the services of an individual employee, you also hired his personal problems, his tastes, his ambitions, and his background. And buried among these traits are his motivations; his reasons for working the way he does. To get the best he has to offer, you must appeal to those things which motivate him. You have to offer him something he considers important. But before you can appeal to his motivations, you must understand them.

That's why talking man-to-man is vitally important. It's your opportunity to look inside a man and try to acquaint yourself with some of the facets of his make-up. If you're successful, you will get a glimmer of what incentive will inspire him to better performance. But if you don't get through to him, your judgment of what motivates him has small chance of success.

Man-to-man conversations lead to many worthwhile by-products. All of them help you get better performance from the individual. For one thing, you have opened the door to communication. After a frank and friendly session the employee will feel he can talk to you. He will be more willing to discuss problems as they arise instead of waiting until disastrous results bring the difficulty to light. Then again, his job becomes more closely associated with

yours. He knows that he's a partner in the enterprise; that his success is important to the overall progress of the company. Being an important part of the operation will build pride in his work. He will do his best not to let you down.

But man-to-man talks don't just happen. They take effort. If you want to start meeting your employees, and learning what makes them tick, you're going to have to learn how to talk with them.

Management consultants feel that the manager's job is essentially that of getting work done through others, and that man-to-man talks are the most important element of their supervisory work. Hugh Wyland, director of industrial relations consulting for Commonwealth Services Inc, and Robert Laws, his assistant director, have assisted several utilities in improving communications between supervisory personnel and the employees under their direction. Although they admit there is no sure-fire method for success in this area, they feel that a systematic approach is better than the haphazard interview which results from playing such situations by ear. Here are some pointers Commonwealth suggests using to help supervisors talk with employees.

Before the Man Comes in . . .

Typically, the supervisor has his secretary make the appointment and schedule it into his calendar. He first begins to think about it when the employee stands in the doorway. Then he spends the first five minutes trying to organize his thoughts while the man squirms in a modernistic chair. Like any spur of the moment activity, the conversation is haphazard. There's only one solution. Do some honest homework before the man shows up.

- **Study the man.** Get his personal folder and brush up on his past experience, his family situation, his hobbies and outside interests. Talk to other people in the company he has worked for and review your own relationships with him. Is he sensitive? Ambitious? Pokerfaced? This study may show a pattern of behavior. If it does, you have some hint of the motivation you will have to appeal to.

- **Examine yourself.** If you're like most people, you are starting out with several biases. You want to recognize these and try to separate yourself from them. Otherwise you won't be communicating. The discussion will become a cross-examination leaving you skeptical of anything worthwhile the man may say.

- **Plan the context of the talk.** Have all the necessary figures right on your desk. This doesn't mean that if the employee hasn't been working up to standards you should store up ammunition against him. But if figures or schedules might come up in the discussion, have them handy.

- **Pick a favorable time.** Try to make it mutually convenient. An edict to "Appear before me at 9 am and show cause" kills the friendly atmosphere then

and there. Show consideration for the employee's schedule.

• **Make the appointment yourself.** It's usually best not have your secretary call. She may be charming but all she does is remind the employee that you're a little bigger in the company than he is. Sometimes the best way to make the date is by a comment in the elevator. "Say, Joe, if you're free around 11, would you drop in and see me" is just about perfect.

• **Pick the proper place.** Usually this is your office, a conference room, or even his own work area. But if the man is particularly sensitive, or if he has been taking a browbeating from the top brass, the coffee shop might be a better climate.

• **Don't give too much warning.** If you plan the date a week in advance, your employee has all that time to worry. He will think of the meeting as a trial rather than as a constructive conversation. A few hours of advance notice should do fine.

While He's in Your Office . . .

If you've done your homework well, you know a good deal about the man sitting down on the other side of your desk. But he doesn't know a great deal about you. This means you have to sell yourself while you're talking. Commonwealth Services offers these hints:

• **Put the man at ease.** This is certainly an intangible. Some executives do it with a smile. Others can't do it at all. The best advice is, "Be yourself." Shy away from gimmicks. Offering him a cigar went out with the robber barons. If you can, start in lightly with some outside interest that you both share.

• **Be positive before you become negative.** Tell the man what he's doing well before you mention his shortcomings. If his reports have been coming too late, you might start this way:

"Joe, I've heard several people say that you've done wonders with the report your department makes up. We feel we're getting more information, and better interpretation than we've ever had. But we could make even better use of them if we had them earlier."

• **Ask questions that invite comment from the employee.** Leading questions (Would you agree with me that . . . ?) get you the answer you want to hear. Since they don't tell you anything new, don't waste time with them. The same thing applies to dead end questions. (Are you doing your best?) You get a one word answer that gets you nowhere.

• **Don't use fighting words.** "Failure," "inefficiency," "short-comings" are words that contain a subtle insult. Stay away from them.

• **Don't make comparisons with other people.** Compare the man's performance

to the required standard. Explain why the standard is important. Saying "The last fellow we had was able to meet the deadline," will just make him mad at the last fellow.

• **Don't close the door on future meetings.** If you say "Drop in sometime next week and let me know if there's anyway I can help you", he will drop in. And you may learn far more about him on the second time around.

• **Take your time.** If the employee sees that you're in a hurry to get rid of him, he thinks the meeting is unimportant. You have to convey the impression that this discussion is just as important as anything else on your schedule.

• **Listen.** This is the cardinal rule. You want to know what motivates this man. If you listen carefully, he will tell you. Don't waste the opportunity by drowning him in your own astute observations. Commonwealth's consultants have a rule of thumb on this subject. "If you've done more than half the talking", he says, "you haven't learned about the man. He's learned about you."

After the Man Leaves . . .

The employee has left, and you have a few minutes to yourself before the next order of business. Don't waste it.

• **Evaluate your own reactions.** Did you achieve what you were after? Did you find out what will make him work harder? If not, make a note of the parts of the talk that got you nowhere. When you see him again, you'll be able to stay away from these blind alleys. Also, examine the techniques you used. Did they work? Were you able to put the man at ease? If not, how can you improve your techniques?

• **Fulfill your promises.** If you've mentioned any action that you will take to help him out, start the ball rolling immediately. If he finds that nothing comes of your promises, you've lost him. Nothing you say in the future will impress him.

• **Plan a future meeting.** Make a note to see him in the future. Pick the latest date that the problem can afford. If he doesn't come to see you before then, you should initiate another meeting.

An all important fact to remember, and one which supervisors so often forget, is that one of the greatest contributions you can make toward the solution of an employee's problem is to listen sympathetically. No man can solve a problem unless he can define it, and by being allowed to talk about it, the employee is helped to put his difficulty into clear focus. The manager gets two important benefits from this process. First in listening, he learns something about the man and his motivation. Secondly, by helping the employee to define the problem, the manager may solve it without any further effort.

(Advertisement)

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—Frederick G. Schmidt, Manager Switchgear Division, I-T-E Circuit Breaker Company

Frankly, we had a big decision to make when we were designing this new HK metal-clad switchgear. Should we go ahead with a complete redesign or should we simply add the new features we knew you wanted to our previous models? The latter would have been easier, and it still would have put us well ahead of the field. But we decided it would be more honest to give you the benefit of as much progress as possible as soon as we could. And we were confident that in this case we could give you all these advances at a price no higher than you would pay for equipment with none of them.

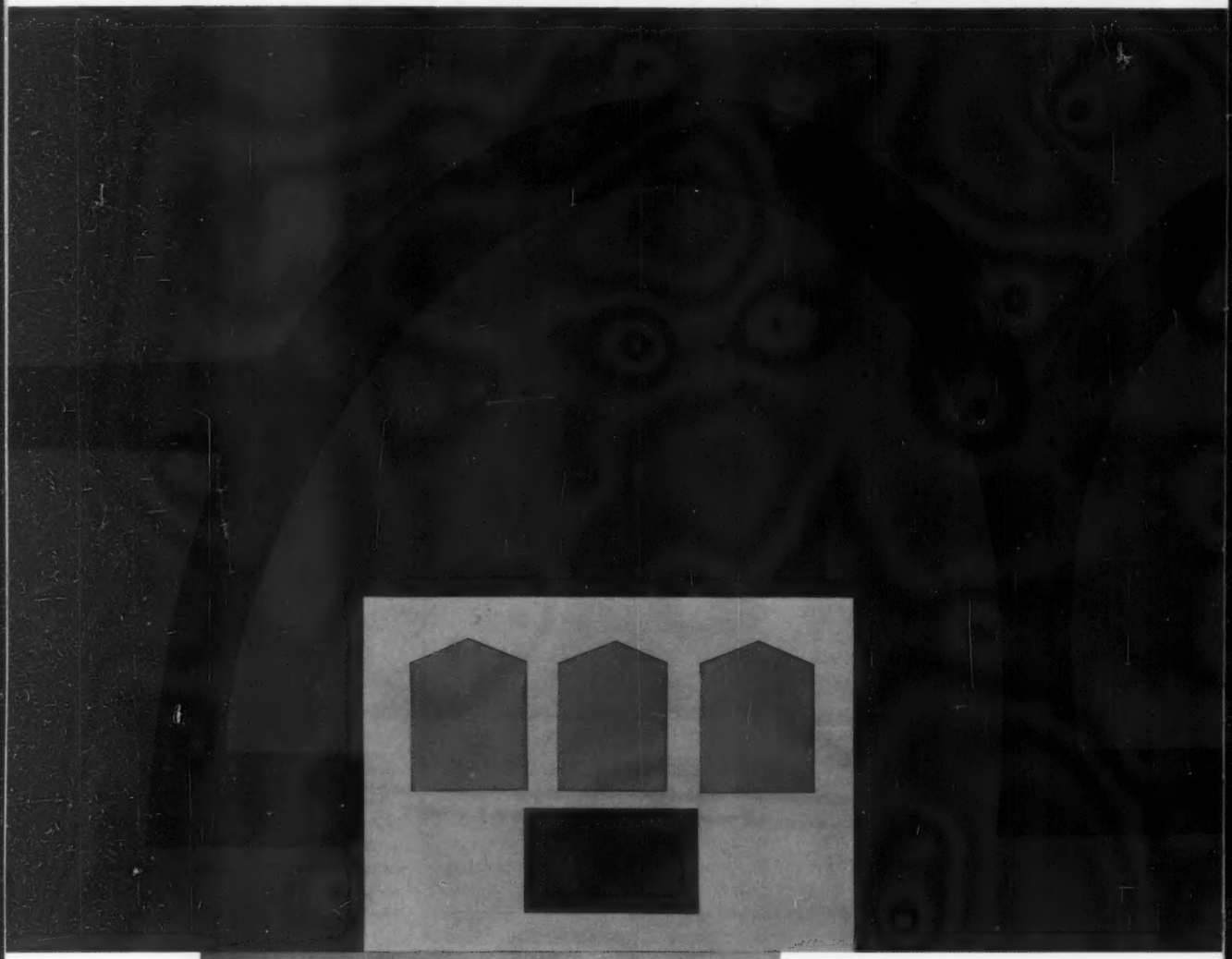
First we wanted to give you stored energy closing. No circuit breaker in this class can really be called modern today without this feature. It insures that you can have fast, uniform closing every time. In fact, I-T-E makes it possible for you to close the breaker even during emergencies when you have lost control power. Fast closing reduces breaker upkeep—prolongs contact life. And I-T-E's motor-driven spring charging mechanism needs only about one-tenth the power of other devices. So you can enjoy the economy of a smaller battery or control transformer.

To give you still greater safety too—again with no increase in cost—we designed this switchgear so you never need open the doors to move the breakers. You can go all the way from connected through test position, to disconnected, and back again with the door closed. Where else can you find safety like this in metal-clad switchgear? Even an inexperienced man can operate it in complete safety. Because we were designing this equipment completely new from the ground up, we had the opportunity to make the components more accessible and provided more elbow room inside the compartments. The bus is higher, for example, making installation and inspection easier. The control cables are brought in at the front for convenience and safe access away from the high-voltage bus. The current transformers are located behind the shutter in the circuit breaker compartment and may be easily changed without disassembling the bus or cable connections.

We were meticulous from the beginning about taking full advantage of the many new materials now available for switchgear use. And through careful selection of materials, skillful arrangement of components, and shrewd economy of space, we were able to give you all these advances in a substantially smaller package as standard equipment. The gear fits under lower overheads and in narrower aisles. Yet it gives you actually more usable space inside than you had before. Circuit breakers are lower, lighter and easier to handle. Instruments are at eye level. We believe you will agree there is no finer switchgear available today anywhere.

A complete description of this equipment is contained in our new illustrated Bulletin 2801-2A. Send for your copy. And ask to see our new sound strip film. We'll bring it to your office. You can see it in 18 minutes. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

Why Electro-Motive peaking



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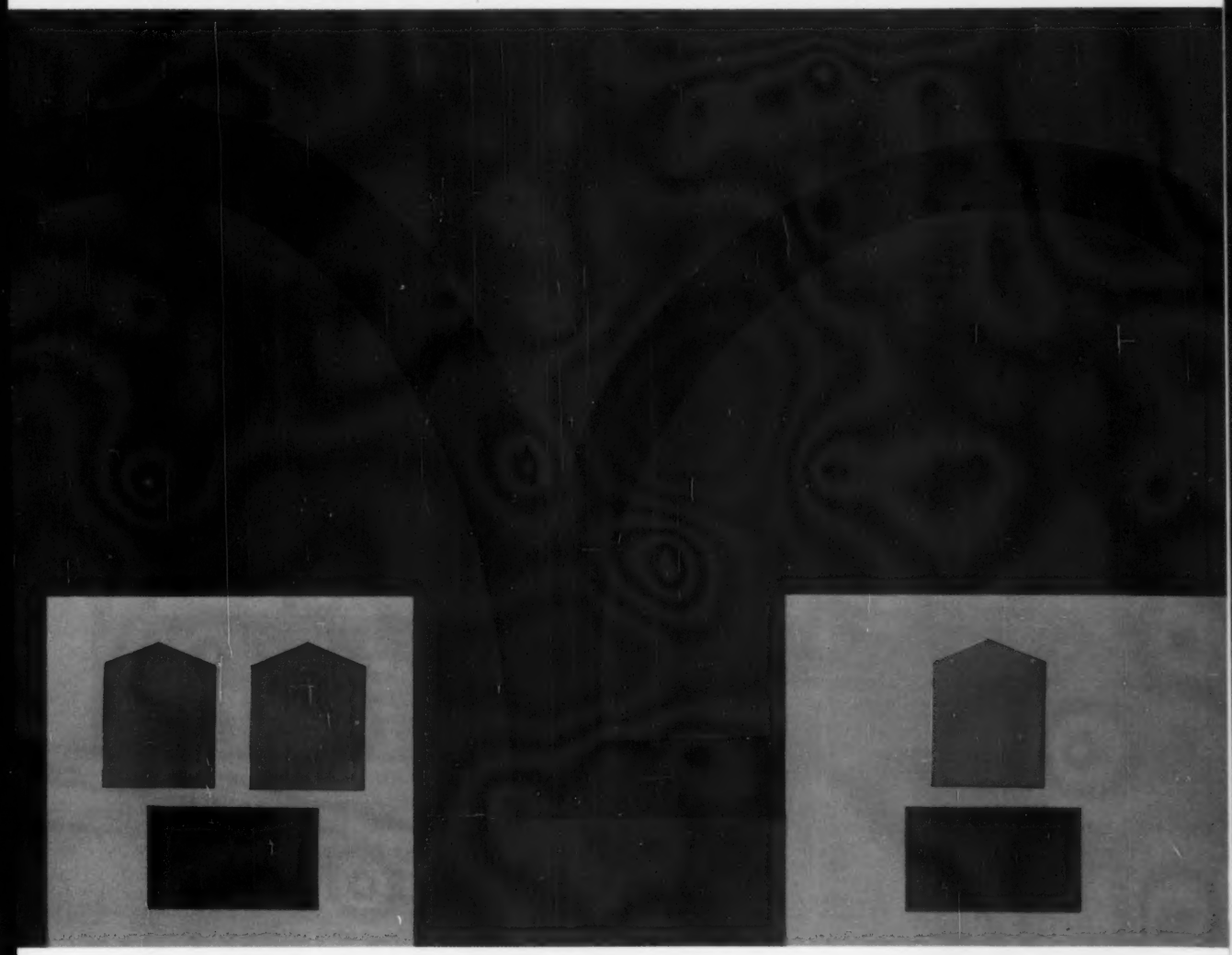

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The messenger is impregnated with a corrosion-proofing thermoplastic compound which becomes an integral part of the cable configuration during the jacketing operation. Breaking strength exceeds 6000 pounds. Can be gripped, pulled and tensioned using standard techniques.

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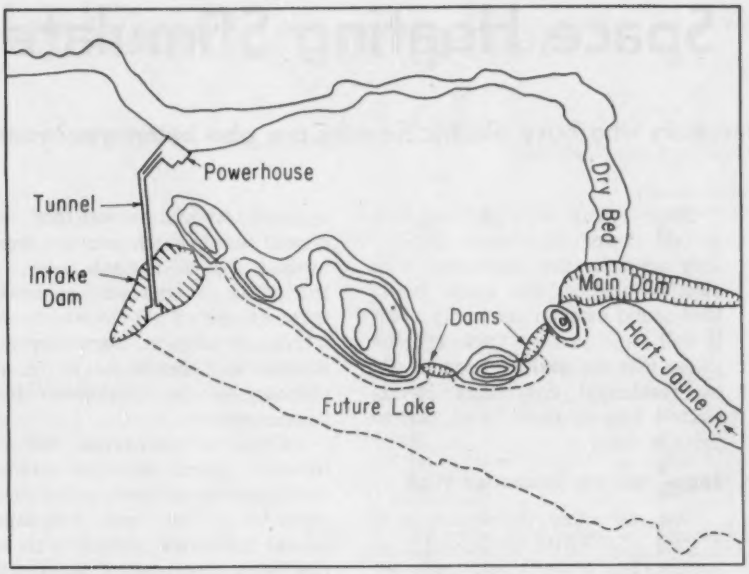
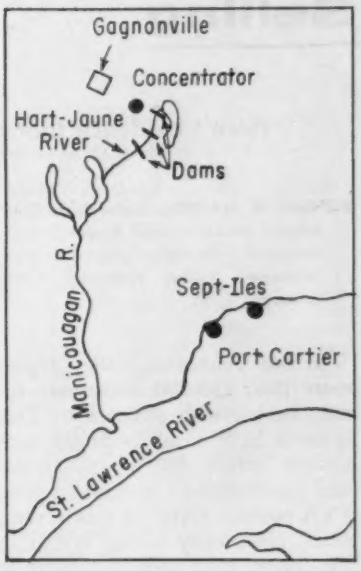


MAIN DAM DIVERTS THE HART-JAUNE to higher ground creating a 50-ft head. A tunnel cuts through the hill carrying water to the 50-Mw powerhouse



IRON ORE MINE, 470 air miles from Montreal, will use the power

Mining Co Plans 50-Mw Dam

Quebec Cartier will tap the Hart-Jaune River in remote area of Quebec to power its giant new iron ore project

Tapping the potential of a little-known tributary of the St. Lawrence River, a 50-Mw installation being built by an affiliate of US Steel Corp is nearing completion in a remote section of eastern Quebec. Intended to supply power for a large iron mining and beneficiating project, the dam will be located on the Hart-Jaune River, a tributary of the Manicouagan River, where the Quebec Hydro-Electric Commission is currently working on a huge hydro development. The mine and concentrator, owned by Quebec Cartier Mining Co, will handle some 20 million tons of hematite ore per year.

A three-dam complex will tap the hydro potential of the Hart-Jaune. Power for the mine's present needs will come from three 22,000-hp turbine generators located at the 50-ft falls site (see map above, left). The main dam diverts the Hart-Jaune from its natural course and forces it to higher ground south of a hill. Here its flow is blocked by the power dam, forming a lake with a 1,525 ft elevation, about 60 ft higher than the original Hart-Jaune valley.

To take advantage of the head, a tunnel will cut through the hill to the powerhouse which will be built at the lowest possible point in the valley. Water drops 50 ft in this tunnel before it reaches the turbines.

Two other dams will regulate the flow of the river. The first will be a storage dam located three miles from Little Manicouagan Lake. Besides increasing the water elevation of the lake to 1,671 ft, it will regulate the flow of the river. Plans call for a re-regulating dam further downstream. To build this structure, the river will be temporarily diverted by cofferdams to an alternate route through a 210-ft man-made canal. In the future, it may serve as an additional power site.

The power project is just one of several major activities connected with the development of the Lac Jeannine mine. Quebec Cartier is also building a 193-mile railroad from the concentrator to Port Cartier. The Port is being dredged to a depth of 50 ft below low tide, making it one of the deepest harbors in Canada. In addition, the company will build two towns for its employees, one called Gagnonville, near the mine and the other at Port Cartier. The power project will supply power to Gagnonville. Port Cartier will receive its power by transmission line from Hydro-Quebec's Manicouagon projects.

Letters

(*Continued from page* 5)

personnel for other duties, the automatic control of these machines will assure safe starting and loading rates so important, as Mr. Sinton recognizes, with older units on standby reserve. To our knowledge this is the first application of automation for previously installed machines. Since these old machines have separate nozzle chests, the programming for automation will not be restricted by any special precautions needed to prevent cylinder cracking.

D. J. Nairn
Manager, Product Sales
Thermal Power Department
Allis-Chalmers Mfg Co
Milwaukee, Wisconsin

Selling

Space Heating Stimulates

Here's evidence that consumers who have electric heating are also better year-round

BUFORD H. MARTIN, Supervisor, Commercial and Industrial Power Section, Electrical Demonstration Branch, Tennessee Valley Authority, Chattanooga, Tenn.

In the Tennessee Valley region more than 250,000 homes are totally heated with electricity. This is about 22% of all residential consumers served by the municipal and cooperative systems selling TVA power. Over the past several years, electrically heated homes in the region have been increasing at a rate between 20 and 25,000 per year. Many of these are in complete subdivisions. Some are small, 10 to 20 homes; others comprise 100 to 200 homes.

Experience Base Is 15 Years

Over the past 15 years there has been ample opportunity to observe the operating experiences of the various power distributing systems serving these homes as the electric heating load developed. The benefits of the space heating load can now be well evaluated. One such benefit is the load building influence on the use of other appliances. In the electrically heated home, certainly cooking, water heating, and clothes drying will also be done electrically. Also, the electrically heated home is generally better lighted. In electrically heated homes not initially equipped with air conditioning and clothes dryers, these appliances can usually be added without increasing service facilities.

Surveys made in cooperation with several power distributors indicate very definitely that consumers with electric heating are much better year-round users of electricity. This is well illustrated by Table I which shows that the average summer use by residential consumers having electric heat is about twice that of those without it.

Space Heating Saturation High

One municipal distributor, with a total of 74,810 residential customers, has a 46% saturation of electric house heating or 34,421 residential heating customers. In 1959, these heating customers used over 71% of the total residential kwhr. In that year their average use for all purposes was 19,300 kwhr. Average for the 74,810 customers was 12,640 kwhr. This distributor estimates that of the average use of 19,300 kwhr per heating customer, 12,600 kwhr were for heating.

Table II shows the connected load and feeder demand data for six groups of electrically heated homes in four locations of Tennessee. All houses in Group V are heated with forced air central furnaces with one thermostat control. All other groups are heated with individual room radiant-convection wall heaters with built-in thermostats. In all groups each house has electric cooking, water heating, refrigeration, lighting and appliances.

The attitude of the utility management determines whether residential subdivisions are developed around the all-electric home. If the utility is interested in serving large groups of all-electric homes, it must develop an aggressive promotion and should be in on the planning of the subdivision from its inception.

Failure to coordinate the distribution system with the building development will cause many headaches for all concerned. The utility should cooperate closely with the real estate development agency, the investment builder, and the contractor. A complete plan of the lot layout should be submitted to the utility so the ultimate distribution facilities can be planned in the beginning, even though building may be scheduled over several years. Only in this manner can the utility provide the most efficient and economical service.

Efficiency Higher in Apartments

In apartments and housing projects, the individual living units usually have less heat loss than a single residence because there is less exposed area per volume. In the TVA area, average heat loss per unit is about 10 kw. Table III shows basic data for a 400-unit low-rent project in an area with a normal heating season of 3,206 degree days. In addition to lighting, each unit has a refrigerator, range, water heater, and an average of 9.76 kw of space heating.

Table IV shows the effect of

Table I—Average Kwhr of Consumers . . .

	...With Electric Heat	...Without Electric Heat
June	749	420
July	769	418
August	883	460
September	787	432
Average	797	433
Annual	20,543	5,986

Table II—Average Demand Analyzed by Groups

Group	I	II	III	IV	V	VI	Total
No. homes	10	11	17	25	54	73	190
Connected heating, kw	128	172	247	305	709	949	2,510
Av. per home, kw	12.8	15.6	14.5	12.2	13.1	13.0	13.2
Max. feeder demand, kw*	97	98	136	216	560	512	1,619
Av. per house, kw	9.7	8.9	8.0	8.6	10.4	7.0	8.5
Min. temperature, F	−1	18	18	.....	18	.....	.....

* All uses

converting an existing 497-unit project from coal to electric heating. The calculated heat loss per unit averaged 9.5 kw for a 65-F TD.

An example of heating load in military housing projects is illustrated by Table V which is a 600-unit air-base housing project in an area with a normal heating season of 3,500 degree days. Each unit has a refrigerator, range, water heater, and an average of 10.34 kw of space heating.

Space heating loads in large commercial and industrial buildings vary much more than the residential applications. One reason is the varying amounts of heat gain from lighting, power, and occupants. In stores which are between other heated buildings and have heated space overhead, lighting may provide most of the required heat during business hours. Electric heaters operating at nights when the lights are off will establish demands little greater than normal lighting demand. This improves load factors for the utility and makes operating costs economical for the customer.

Teamed With Air Conditioning

Usually electrically heated stores are air conditioned, especially in the TVA area, and the maximum demand frequently occurs in the summer. This is also true of office buildings where the lighting load is heavy and many people are employed. Table VI reflects the load characteristics of an eight-story office building with total floor area of 70,560 sq ft. This building has forced air circulation through ducts radiating from a central equipment room on each floor. Heating is accomplished by banks of resistance heaters in the ducts leading to various offices. This provides a good diversity of the total heating load.

The largest resistance heating installation in an office building we have on record in our region has a connected load of 1,800 kw. It is basically a circulating water system which can be used for heating or

Table III—Basic Data for 400-Unit Low-rent Project

Fiscal 1955*	Demand per Unit-Kw†	Kwhr Per Unit	Load Factor	Min Temp, F	Degree Days‡
July '54	1.08	444	57%	63	0
Aug	1.20	480	52	63	0
Sept	1.20	480	56	47	3
Oct	3.96	888	31	30	173
Nov	5.52	1,938	47	19	560
Dec	5.52	2,664	65	22	761
Jan '55	6.00	2,724	61	15	768
Feb	6.48	2,280	47	13	550
Mar	4.74	1,692	53	17	370
April	3.12	912	39	35	80
May	1.44	504	49	46	6
June	1.32	528	54	52	1
Total for year		15,534			3,272

* Billing period data (meter read approximately last day of month)
† Project metered at 4 kv; demand divided by number of units
‡ Normal season degree days = 3,206

Table IV—Low-rent Housing Projects Load Characteristics*

	Before Electric Heat (1956)		After Electric Heat (1959)		Increase (1959 minus 1956)	
	Kw/ Unit	Kwhr/ Unit	Kw/ Unit	Kwhr/ Unit	Kw/ Unit	Kwhr/ Unit
July	1.2	351	1.3	467	0.1	116
Aug	1.1	367	1.3	419	0.2	52
Sept	1.2	369	1.5	451	0.3	82
Oct	1.5	419	2.6	660	1.1	241
Nov	1.6	528	3.2	1,046	0.6	518
Dec	1.7	534	5.2	1,899	3.5	1,365
Jan	1.8	616	5.9	2,398	4.1	1,782
Feb	1.7	592	4.8	1,883	3.1	1,291
Mar	1.6	489	4.8	1,738	3.2	1,249
April	1.8	533	3.7	1,143	1.9	610
May	1.7	446	2.4	579	0.7	133
June	1.5	396	1.6	467	0.1	71
Annual total	18.4	5,640	38.3	13,150	19.2*	7,189†
Load Factor:						
Monthly average		42%		47%		52%
Annual		36		25		20

* 497 units—heat loss at 65F temperature difference = 9.5 kw per unit
† Eight heating months, Oct-May

Table V—Basic Data for 600-Unit Air Base Project

Fiscal 1955*	Demand Per Unit, Kw‡	Kwhr Per Unit	Load Factor,†	Min Temp., F	Degree Days
July '54	1.38	642	65%	61	0
Aug	1.44	678	63	62	0
Sept	1.47	672	61	55	0
Oct	1.65	630	53	46	24
Nov	5.37	1,494	37	19	454
Dec	5.52	2,070	52	23	648
Jan '55	5.58	2,256	54	18	691
Feb	6.63	2,838	58	7	947
Mar	5.04	1,530	45	25	355
April	5.88	1,548	35	16	401
May	2.76	636	32	46	24
June	1.44	600	56	49	7
		15,594			3,551

† Annual load factor 27%
* Billing period data (meter read approximately 15th of each month)
‡ Project is metered at 13 kv; total demand divided by number of units.

Table VI—Eight-Story Office Building

(Reinforced concrete, walls brick veneer over concrete block, plastered inside)

Connected load

Lighting	189 kw
Water heating	10
Power	50
Space heating	371
Air conditioning	224

Operating data

Month	Demand, Kw	Kwhr
July '57	400	153,600
Aug	392	155,200
Sept	376	139,200
Oct	376	118,400
Nov	400	106,400
Dec	352	115,200
Jan '58	376	135,200
Feb	415	104,800
Mar	408	110,400
April	336	108,800
May	384	113,600
June	400	133,600
Total		1,494,400
Annual Load Factor		41.24%

Table VII—Heat Pump Installation in Garment Industry (Tennessee)

(8-in. concrete block, brick veneer; no glass except office space; floor 5-in. concrete on gravel; 2-in. peripheral insulation and 4-in. mineral wool under flat roof with 18-in. air space.)

Calculated heat loss at 70F temperature difference = 370 kw

Estimated internal heat gain from lighting and power = 80 kw

Connected load

Lighting and power	80 kw
Heating (auxiliary)	169 kw
13 heat pumps	97.5 kw
Total	346.5 kw

Operating data

Month	Kw	Kwhr
Sept '56	123.2	29,120
Oct	131.6	29,600
Nov	109.5	28,640
Dec	108.1	40,160
Jan '57	164.0	41,760
Feb	164.0	42,000
Mar	125.6	39,120
April	116.8	33,520
May	125.1	34,880
June	131.9	34,640
July	130.6	37,440
Aug	138.4	47,440
Total		435,320
Annual Load Factor		30%

cooling. Each office space has individual thermostatically controlled auxiliary water heaters which help balance heating for the sunny or cold sides of the building. Annual load factor runs around 33%.

The number of heat pumps for year-round air conditioning in churches, offices, stores and industrial plants has been growing quite rapidly in the past three years. Today, there are ten churches in this area with heat pumps ranging from five to 150 hp. Thirty-nine utility office buildings and one six-story insurance office building are conditioned year-round with heat pumps. One hospital addition now under construction will have a 300-hp heat pump.

One garment industry installed heat pumps in preference to conventional air conditioning and oil heat because of the automatic switchover from heating to cooling. This industry is located in an area with very cool nights but warm days in the fall and spring. Over 100 women work in the plant. The heat pump warms the building in the early morning. When work starts, and heat from motors, lights and workers is released in the building and the outside temperature rises, the system automatically switches to cooling. The superintendent states that he has excellent employee morale with practically no labor turnover. He feels his heating and cooling system is one of his greatest assets in good labor relations. Table VII shows the monthly demand and energy records for a 12-month period.

There are now 22 all-electric schools in the Tennessee Valley area, ranging from four to 15 classrooms. Seven others are under construction. One of these, a high school, has six buildings with a total area of 123,000 sq ft and a heating load of 1,650 kw. Equipment used includes wall heater, baseboard heaters, unit ventilators, and blast coils built into air ducts. These latter are utilized with air conditioning equipment in the auditorium.

One false assumption held by most architects and consulting engineers is that the full connected load of the heating system will be added to the demand for other uses. This is of major importance in discussing operating cost with school authorities. This idea is also taken advantage of by those interested in selling other systems of heating. They always insist on using the full connected heating load wherever a demand rate is in effect. Many examples now demonstrate that the incremental demand resulting from electric heating is more on the order of 40 to 50% of the connected load. Obviously this diversity is obtained only with individual room control.

Body Heat Helps in Schools

When school is in session, the heat from lighting, body heat of the pupils and solar gain offsets much of the heat loss of the building. Moreover the heating capacity of the system is based on the maximum design temperature difference which seldom occurs during school hours. Often the lighting alone will offset the building heat loss on mild days. Table VIII gives the connected loads for lighting, cooking, water heating and space heating of a 150 classroom school in Tennessee and shows the actual monthly demand and kwhr for a 12-month period.

Table VIII—15-Classroom School (Tennessee)

(Modern 30,000-sq-ft building has 15 classrooms, gymnasium, cafeteria, clinic, lounges and office.)

Connected Load

Lighting (incandescent)	135 kw
Cooking	70
Water heating	40
Space heating	356
Total	601

Operating Data

Month	Kw	Kwhr
July '57	40	4,800
Aug	72	5,760
Sept	184	31,920
Oct	192	64,960
Nov	248	77,120
Dec	312	112,160
Jan '58	320	129,280
Feb	352	105,600
Mar	248	76,480
April	232	36,000
May	96	10,560
June	96	6,880
Total		643,520
Annual Load Factor		20.87%
Degree days in heating season (133.5% of normal)		4,151

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Since American Bridge first introduced the use of high strength steels in transmission towers, savings have been effected on scores of new transmission lines in all parts of the country. ☐ This new 110 KV double circuit line for Baltimore Gas and Electric is a typical example. By using both USS MAN-TEN and A-7 Carbon Steel to their best advantage, just over a ton of dead weight was trimmed from each of 86 towers, resulting in both material and handling savings. ☐ American Bridge, the world's leading transmission tower specialist, has recently designed towers to carry the highest voltages likely to be used for the next decade. ☐ For recommendations based on your requirements, write American Bridge Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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American Bridge Division of United States Steel

USS

I&M Electric Appoints Miller Division Head

JAMES H. MILLER

James H. Miller has been chosen to succeed Arnold Hogan as manager of Indiana & Michigan Electric Co's Marion-Muncie, Ind., division. Hogan has retired as vice president of the company and division manager. I&M Electric is a subsidiary of American Electric Power Co.

Miller, formerly assistant manager of the division, joined American Electric Power System's Appalachian Power Co in 1927 as a power engineer. He was transferred to Indiana General Service in 1934, and was named division power sales engineer in Marion in 1941. Four years later, Miller came to Muncie as district manager, and became assistant division manager in 1952.

Three Named Executives of Newly-Formed Brill Engineering

RALPH C. ROE CLINTON B. F. BRILL KENNETH A. ROE

A new firm, Brill Engineering Corp, has been formed by the merger of the interests of Col Clinton B. F. Brill and the Franklin Engineering Corp, a subsidiary of Burns & Roe, Inc.

Ralph C. Roe was named company chairman, Col Brill president, and Kenneth A. Roe vice president.

Ralph Roe, founder of Burns & Roe, has been that company's president and board chairman since its inception in 1935.

Col Brill (US Army Reserve, retired) was chairman of the New York State Thruway Authority from 1957 until earlier this year. He had responsibility for construction, operation, and maintenance.

Kenneth Roe joined Burns & Roe as a mechanical engineer. He was subsequently chemical engineer, project engineer, executive administrative engineer, and, in 1954, was promoted to executive vice president.

PERSONAL BRIEFS

The new manager of the Southern Berkshire Power & Electric Co is **Allen M. Herrmann,** replacing **Guy W. Nichols.**

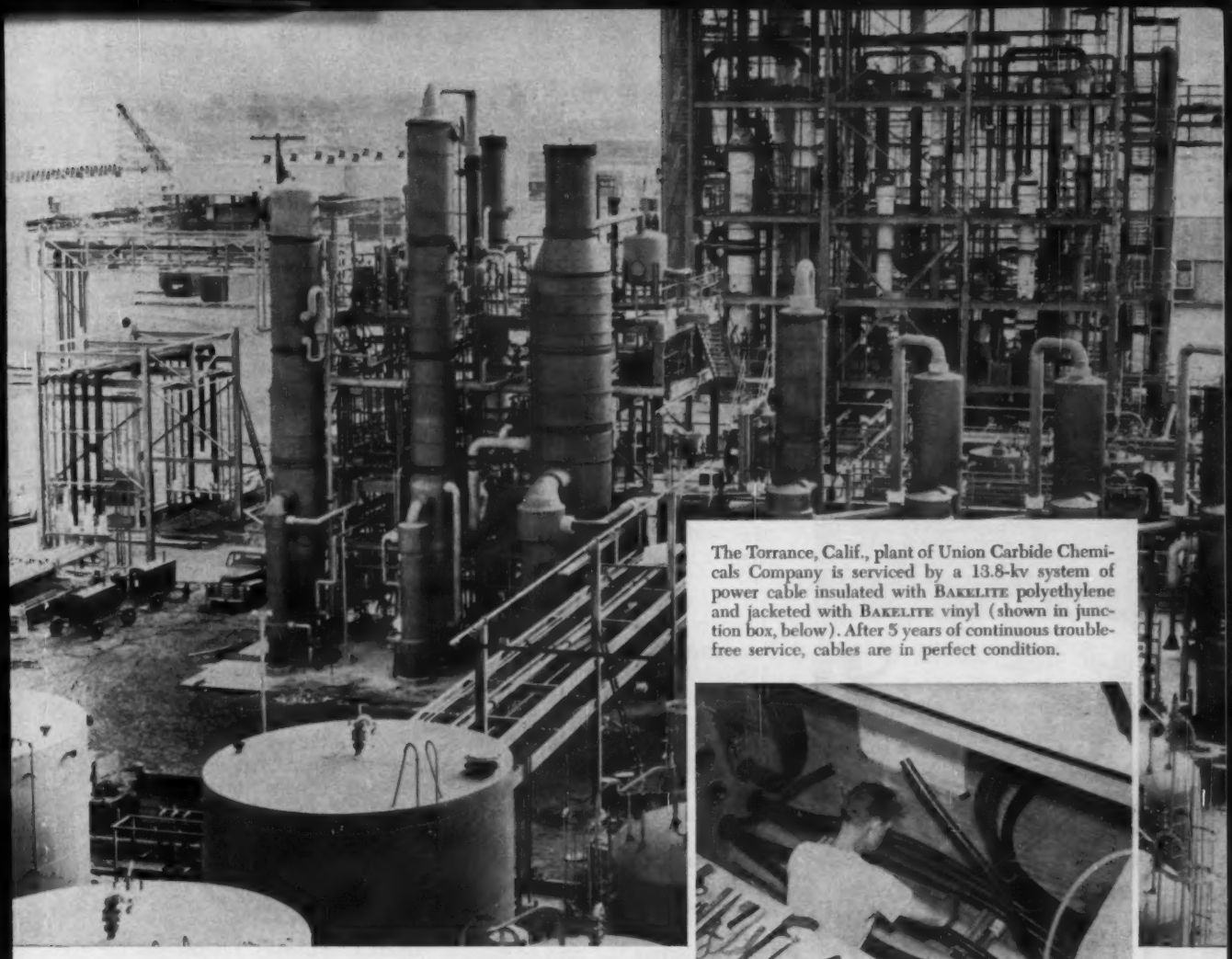
Howard E. Stockwell has been transferred from superintendent of electric maintenance, New England Electric System, Shelburne Falls, Mass., to assistant operating engineer in Boston.

Lindley K. Nichols has joined the management consulting division of Ebasco Services Inc as chief consultant.

William Nordeen, former manager of the Douglas County, Wash., Public Utility District, has replaced **Ora Beasley** as manager of Northern Lights, Inc, Sandpoint, Ida. Beasley resigned.

At Arkansas Power & Light Co, **Max Sudduth** has been chosen to establish and direct a new market research and statistics department, **Harvey Nichols** to manage the new sales planning, promotion and training department, and **John S. Williams** to manage the new technical operations and field assistance department. Also, **Thomas A. Edwards** has been appointed head of the new program to help electrical appliance distributors and dealers establish repair and service facilities for the appliances they sell, and **N. R. Bowers** succeeded Edwards as manager of the Little Rock office of

(*Continued on page* 118)



The Torrance, Calif., plant of Union Carbide Chemicals Company is serviced by a 13.8-kv system of power cable insulated with BAKELITE polyethylene and jacketed with BAKELITE vinyl (shown in junction box, below). After 5 years of continuous trouble-free service, cables are in perfect condition.

Polyethylene-insulated, vinyl-jacketed power cable

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Electrical utilities, electrical contractors and engineers, and cable manufacturers . . . all can benefit from the wide selection of BAKELITE high- and low-density polyethylene and vinyl materials specifically designed for insulation and jacketing. For more information about these materials, write Dept. GK-43, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

Cable for this installation supplied by: Anaconda Wire & Cable Co., New York 4, N. Y. and Rome Cable, Division of Alcoa, Rome, N. Y.

UNION CARBIDE

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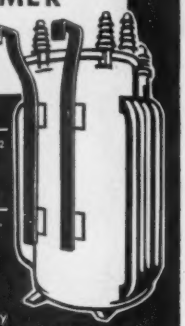

MODEL	C-1	C-3
Transformer	75-100 KVA Single-Phase	75-112½ KVA Three-Phase
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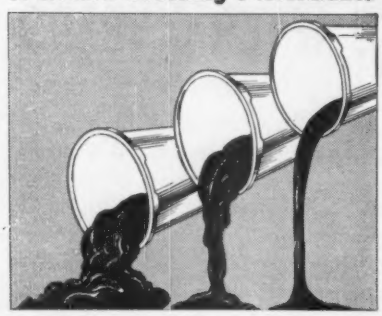

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MINERALLAC

La Faso Becomes EW's Circulation Manager

Sam A. La Faso has joined *Electrical World* as circulation manager. The former vice president of Ebasco International Corp succeeds E. B. Sessions, who has been assigned to advertising sales for the Atlantic district.

La Faso has been in the utility field for more than 25 years, since joining the Utility Management Corp, New York service organization for Associated Gas & Electric group of companies, now General Public Utilities group.

He held managerial posts in sales, advertising, and public relations with subsidiaries of General Public Utilities in New York, Pennsylvania and New Jersey before coming to Ebasco in 1957. He was elected vice president and a member of the board of directors in 1959.

LA FASO

Personal Briefs (*Continued from page* 116)

the company's Adequate Wiring Bureau.

Duke Power Co has named **J. E. Chapman** manager of the electrical maintenance and construction department, **E. B. Shuler** manager of the transmission lines department, and **W. T. Reeder Jr** superintendent of transmission lines.

Carl O. Carlson has been promoted to the newly-created post of assistant chairman of the board of Atlantic City Electric Co. He was also elected to the board of directors.

Donald J. Gray has joined Mississippi Power & Light Co as management consultant.

Elmer Landin has been promoted from auditor to administrative assistant at Washington Public Power Supply System.

The Atomic Energy Commission has named **William L. Ginkel** operations division director of the Idaho operations office.

Black Hills Power & Light Co has named **Doris M. Quackenbush** home service director.

At Wisconsin Electric Power Co, **Charles S. McNeer** has been promoted to assistant manager of electrical engineering, and **Nicholas A. Ricci** became assistant manager of electrical operation.

Wendall Phelps has been elected president of the Inland Empire chapter of the Illuminating Engineering Society. Other officers elected were **Ray Rookey,** vice president, and **John Wessells,** secretary-treasurer.

Albert C. Salansky has become office manager for the Clearwater Power Co, REA co-op at Lewiston, Ida., succeeding **Albert J. Frei** who resigned.

David H. Gulvin has succeeded **William J. Naughton** as employee and community relations coordinator for Connecticut Light & Power Co. Naughton was transferred to CL&P offices in Berlin, Conn., to be training coordinator.

Robert L. Pulley, vice president and operating manager of Gulf Power Co, has been appointed general manager. **Robert F. Ellis Jr** was named to the newly-created post of assistant general manager, assuming the duties formerly assigned to the operating manager.

E. F. Robinson and **R. J. Williams** have become sales engineers at the Chicago office of Riley Stoker Corp.

S&C Electric Co has made the fol-

lowing promotions: **Jack B. Castle** to head of the newly-formed sales services division; and **Philip J. McLaughlin** to manager of the east central sales division.

De Laval Steam Turbine Co has established two independent operating divisions. **Hans G. Bauer,** executive vice president, will head the machinery division while retaining responsibility for district sales offices and sales representatives, and **C. A. Jurgensen,** vice president, will head the power auxiliaries division.

Robert R. Wylie has been appointed manager of a new electronic products sales group at Sangamo Electric Co, with **Glenn DeKraker,** newly-named manager of marketing services, as his assistant.

The American Standards Assn has presented the Howard Coonley Medal to **James Harold Foote,** vice president of Commonwealth Services, Inc, and the Standards Medal to **Richard C. Sogge,** retired manager of the standards division of General Electric Co.

Peabody Coal Co has appointed **Edwin R. Phelps** chief engineer. **C. P. Arnold,** vice president and chief engineer, became vice president and director of engineering.

John R. Freeman Jr, vice president of metallurgy and research at American Brass Co, has retired to begin service as metallurgical consultant to Anaconda Sales Co. He will continue representing Anaconda Sales as its technical representative in the Copper Products Development Assn.

Named associate directors of Westinghouse Electric Corp's research laboratories are **Dr John W. Coltman,** former manager of the electronics and nuclear physics department, and **Dr John K. Hulm,** former manager of the solid state physics department. **Frank H. Muns** became manager of business systems for the lamp division. Two Westinghouse men received awards for their work: **R. E. Peterson,** manager of the mechanics department of the research laboratories, got the 1960 Machine Design Medal of the American Society of Mechanical Engineers, and Dr Coltman (see above) was the recipient of the Edward Longstreth Medal of the Franklin Institute.

Clark Nichols has become manager of the systems engineering division of Leeds & Northrup Co.

OBITUARIES

Harry B. Batchelder, 60, central division sales manager, Puget Sound Power & Light Co . . . **George M. Allen,** 52, industrial sales director, Detroit Edison Co . . . **James O. Harrison,** 54, quality control engineer, room air-conditioning department, General Electric Co's Appliance Park . . . **Phillipp G. Uhlmann,** 65, superintendent, electric and steam heat sales, Ohio Edison Co . . . **Edward A. Olsen,** 66, former president, Florida Power Co . . . **John T. Kimball,** 70, retired vice president in charge of rates, Niagara Mohawk Power Corp . . . **Everett Goodrich Couch,** 81, retired Darlington manager, Carolina Power & Light Co . . . **Leon A. Watts,** 81, retired manager, Allis-Chalmers Manufacturing Co's service and erection department . . . **George H. Jarden Sr,** 59, assistant superintendent, transmission and distribution department, Philadelphia Electric Co . . . **Harry T. Crissey,** 86, of Crissey's Electrical Supply Co . . . **Robert L. Phillips Sr,** 58, a supervisor at Louisville Gas & Electric Co . . . **James Ernest Winders,** 43, Tennessee Valley Authority employee . . . **Ralph Douglas Booth,** 61, president of Jackson & Moreland Inc . . . At Public Service Electric & Gas Corp: **Charles L. Sterling,** 68, former senior engineer, electric engineering department; **William D. Potts** and **Julius D. Oleson,** formerly with the electric distribution department, Trenton area, southern division; **Joseph T. Bengeyfield,** retired substation department employee, electric distribution department, Bergen division; and **Oga C. Kiehn,** 59, of the electrical distribution department, Hudson division.

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P. HAMMOND

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Holcombe Blvd., Rm. W-724
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Medina Electric Cooperative, Inc. is receiving applications for Senior Operators, Control Operators, and Plant Electricians for employment in a new 66,000 KW Steam-Electric Generating Plant 50 miles south of San Antonio, Texas. Send complete resume to Medina Electric Cooperative, Inc., Box 1028, Pearsall, Texas.

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SELLING OPPORTUNITY AVAILABLE

Representative wanted for manufacturer of street lighting equipment pole line specialties. Western States. Full particulars. RW-5056, Electrical World.

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Invitation No. DS-5447) will be received at Denver, Colorado, until 2 p.m., Mountain Standard Time, January 5, 1961, for furnishing two 83,333-kva, 13,800-volt, 225-rpm, vertical-shaft, hydraulic-driven generators for Spring Creek Powerplant, Central Valley Project, California. Installation required within 840 days for 1st unit and 930 days for 2nd unit. For particulars, address Bureau of Reclamation, Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner

---

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3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
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3— 500 KVA Penn. 13200-120/240
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA GE 66000—2400/4160Y
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1	5000	West.	115,000—13,750, 3 Ph.
1	10000	West.	67,000—34,500, 3 Ph. Auto.
1	3750	G. E.	69,300—13,200, 3 Ph.
1	3000	G. E.	69,000—4340, 3 Ph.
4	2000	Amer.	67,650—22,000
3	1250	G. E.	69,300—2400/4160
4	333	West.	67,000—7200/12470Y
1	2500	Mol.	44,000—2400/4160, 3 Ph.
5	833	G. E.	44,000—480
3	333	G. E.	44,000—480
1	5000	West.	34,500—13750/6875, 3 Ph.
1	4500	West.	33,000—2500/4330, 3 Ph.
2	3000	Upef.	34,750—4160, 3 Ph.
2	1500	G. E.	34,400—2520, 3 Ph.
3	1250	A. C.	33,000—480
3	500	Mol.	34,500—2300/4600
3	200	A. C.	34,500—2400/7200/12470Y
2	3000	G. E.	26,400—4160Y/2400, 3 Ph.
2	3000	G. E.	13,800—2640, 3 Ph.
1	2500	G. E.	13,800—2400, Unit Sub.
3	667	G. E.	13,200—240/480
1	600	Stand.	13,200—2300, 3 Ph.
3	500	G. E.	13,200—240 x 480
1	450	Penna.	13,200—2400, 3 Ph. Askarel
3	333	G. E.	13,800—230/460
3	100	A. C.	6,900—2400
1	1000	A. C.	2,400/4,160—240, 3 Ph.
3	400	G. E.	2,300/4,000—230/460

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1	4600 Kw, 60 cycle, 13800 volts, Generator 6500 Hp, 25 cycle, 11000 volts, Motor—300 Rpm
1	1500 Kw, 60 cycle, 2300 volts, Generator 2100 Hp, 25 cycle, 2300 volts, Motor—300 Rpm
2	1000 Kw, 60 cycle, 2300 volts, Generator 1580 Hp, 25 cycle, 2300 volts, Motor—300 Rpm

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Meetings Calendar

DECEMBER

Interstate Power Club—Beverly Hotel, New York City, Dec. 12.

American Nuclear Society—Winter Meeting, Mark Hopkins Hotel, San Francisco, Dec. 12-15.

Electric Companies Public Information Program—Steering Committee, Edgewater Beach Hotel, Chicago, Dec. 13.

National Safety Council—Fall Meeting of the Executive Committee, Public Utilities Section, Statler Hilton Hotel, New York City, Dec. 13-14.

Eastern Joint Computer Conference—New Yorker Hotel and the Manhattan Center, New York City, Dec. 13-15.

Atomic Industrial Forum—Annual Conference, Fairmont Hotel, San Francisco, Dec. 14-16.

Edison Electric Institute—Residential Electric Heating & Air Conditioning Committee, Cincinnati, Ohio, Dec. 15-16.

JANUARY

Symposium on Thermoelectric Energy Conversion—Statler-Hilton Hotel, Dallas, Jan. 8-12.

• **Pennsylvania Electric Association**—Advertising Committee, Harrisburg, Jan. 9-10; Residential Committee, Mountain View Hotel, Greensburg, Jan. 16-17; Customer Contact Committee, Philadelphia, Jan. 18; Accident Prevention Committee, Holiday Motor Lodge, Harrisburg, Jan. 19-20; Street and Highway Lighting Committee, Harrisburg, Jan. 19-20; Personnel Practices Committee, Philadelphia, Jan. 26; Communications Committee, Pittsburgh, Jan. 26-27; Stores Committee, York, Jan. 26-27; Structures and Hydraulics Committee, Benjamin Franklin Hotel, Philadelphia, Jan. 26-27.

Reliability & Quality Control Conference—Sponsored by the AIEE-IRE-ASQC, Bellevue-Stratford Hotel, Philadelphia, Jan. 9-11.

Edison Electric Institute—Home Service Committee, Chicago, Jan. 11; Live Better Electrically Women's Conference, Edgewater Beach Hotel, Chicago, Jan. 12-14.

Instrument Society of America—Winter Instrument-Automation Conference & Exhibit, Kiel Auditorium, St. Louis, Jan. 17-19.

Canadian Electrical Association—Eastern Zone, Nova Scotian Hotel, Halifax, N. S., Canada, Jan. 23-26.

Southeastern Electric Exchange—Legal and Claims Committee, Miami Beach, Jan. 25-26.

Pennsylvania Electric Association — Communications Committee, Jan. 26-27; Structures and Hydraulics Committee, Philadelphia, Jan. 26-27.

American Institute of Electrical Engineers—Winter General Meeting, Hotel Statler, New York City, Jan. 29-Feb. 3.

• **American Society for Testing Materials**—Committee Week, Netherland Hilton Hotel, Cincinnati, Jan. 30-Feb. 3.

FEBRUARY

• **National Electrical Week**—Feb. 5-12.

• **Edison Electric Institute**—Taxation Accounting Committee, Deshler Hilton Hotel, Columbus, Feb. 8-10; National Conference of Electric & Gas Utility Accountants, Chase-Park Plaza Hotels, St. Louis, Feb. 16-19.

• **Missouri Valley Electric Association**—Industrial and Commercial Sales Conference, President Hotel, Kansas City, Feb. 9-10.

• **American Society of Heating, Refrigerating & Air-Conditioning Engineers**—Semi-Annual Meeting, Conrad Hilton Hotel, Chicago, Feb. 13-16.

• **Electrical Trade Conference & Exposition**—Sponsored by Electrical Institute of Washington and the Electrical Manufacturers Representatives Association of Baltimore, Sheraton-Park Hotel, Washington, D. C., Feb. 14-16.

• **Pennsylvania Electric Association** — Electrical Equipment Committee, Pick-Roosevelt Hotel, Pittsburgh, Feb. 16-17.

• Additions this week.

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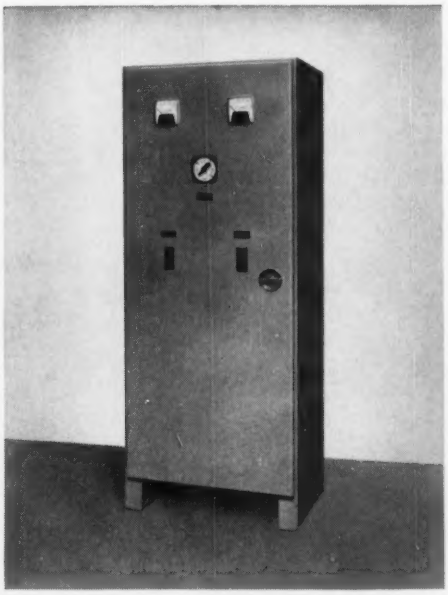

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. . . in stationary batteries. What's your objective: long battery life, low initial cost, high current discharge, quick recharge? With Exide, you're free to choose. If you want a particular type of battery—plante, flat plate, calcium grid—Exide can supply it in a wide range of capacity ratings for any application. Because you have so broad a choice, you can select the one battery that best meets your own requirements. Yet in every case you know you are getting the extra dependability and value only Exide offers. So no matter what type of stationary battery you want, buy with confidence. Buy Exide. Full line of rectifier and motor-generator chargers available to cover any application requirements.

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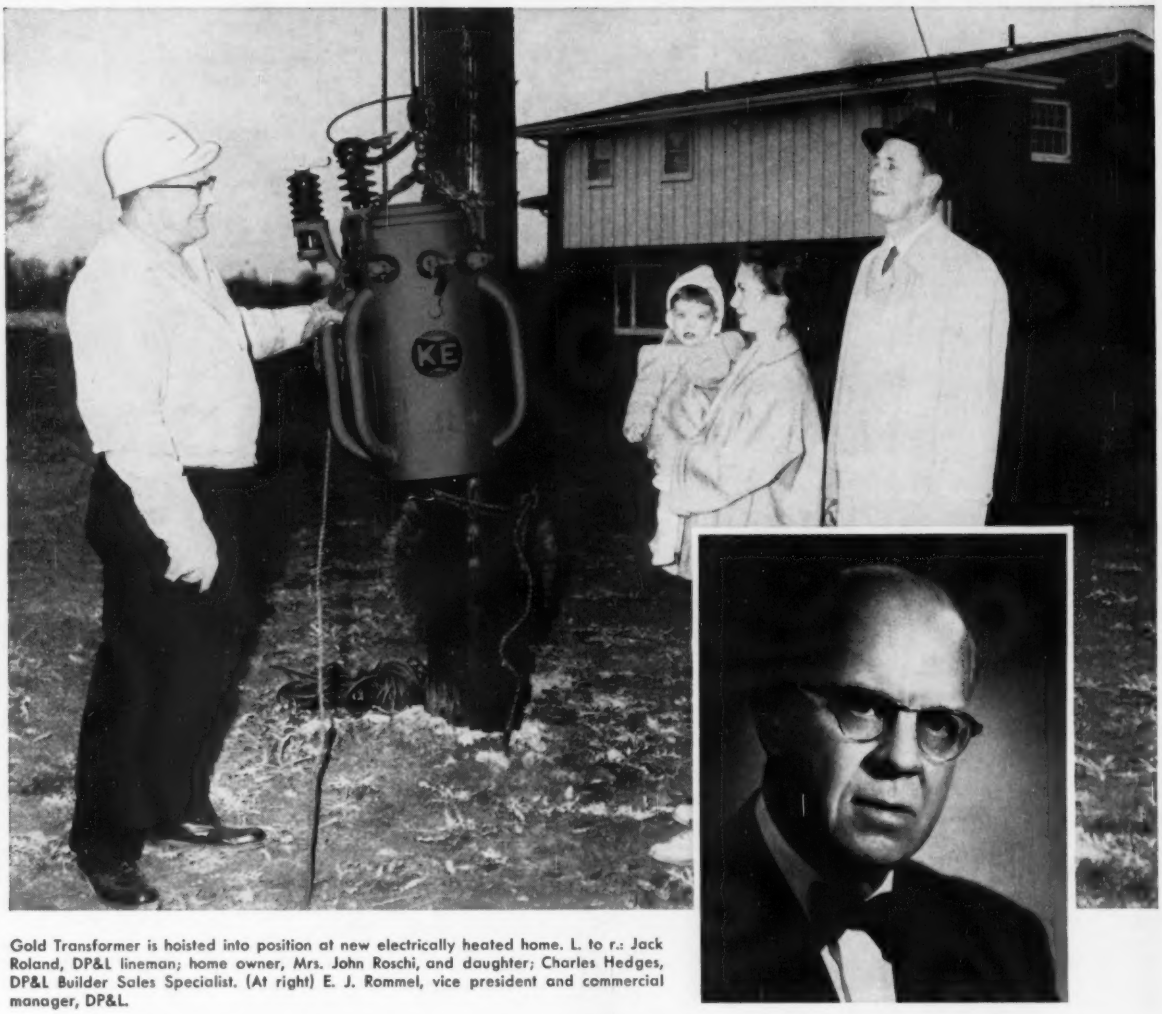
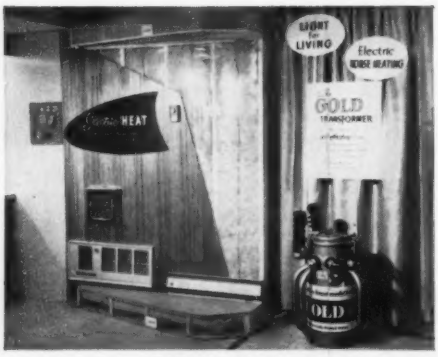


Gold Transformer is hoisted into position at new electrically heated home. L. to r.: Jack Roland, DP&L lineman; home owner, Mrs. John Roschi, and daughter; Charles Hedges, DP&L Builder Sales Specialist. (At right) E. J. Rommel, vice president and commercial manager, DP&L.

Dayton Power and Light installs GOLD TRANSFORMER to serve a new electrically heated home



Gold Transformer features lobby display on electric heat.

"The Gold Transformer promotion is an integral part of DP&L's 'Sizzling '60' Sales Program," states DP&L's E. J. Rommel. "We set a 1960 goal of 175 new electrically heated homes, and progress to date indicates we will exceed that number by a substantial margin."

The bright Gold Transformer, symbol of all-electric living, identifies and dramatizes Gold Medallion homes, builds interest and traffic for these showplace dwellings.

Ask your Kuhlman representative for full information about Kuhlman's Gold Transformer merchandising kit. It will help you use Gold Transformers for greater Gold Medallion sales.

KUHLMAN TRANSFORMERS

KUHLMAN ELECTRIC COMPANY, Birmingham, Michigan

Manufacturers of transformers since 1894

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